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Temperature Variations in Concrete

Civil Engineering

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TEMPERATURE VARIATIONS

IN

CONCRETE

BY

DANIEL HARMON BRUSH, Jr.

THESIS

FOR

DEGREE OF BACHELOR OF SCIENCE

IN

CIVIL ENGINEERING

COLLEGE OF ENGINEERING

UNIVERSITY OF ILLINOIS

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May 26, 1906

This is to certify that the thesis prepared under the immediate direction of Instructor L. A. Waterbury by

DANIEL HARMON BRUSH, JR.

entitled TEMPERATURE VARIATIONS IN CONCRETE

is approved by me as fulfilling this part of the requirements for the Degree of Bachelor of Science in Civil Engineering.

Ira O. Baker

Head of Department of Civil Engineering

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TEMPERATURE VARIATIONS IN CONCRETE.

The object of this thesis was an investigation of the variations of temperature within concrete.

In order to study this subject the experiments herein described were performed, and from the resulting data an effort was made to obtain definite information regarding the variation of the temperature of concrete in relation to that of the air.

The method of investigation which was followed was to observe, at frequent intervals, the air temperature and the temperatures at various points in concrete specimens which were exposed to atmospheric influences. By comparing these readings it was possible to note the relations between the changes in the air temperature, and the changes in the temperature of the concrete for the various points of observation. In order to study the results the data obtained was plotted in the form of curves, which show graphically the rate of change in the temperature at the points of observation, with reference to the time of observation.

Description of Experiments.

The specimens consisted of three concrete cylinders, and one concrete beam, all of which were about one year old. The proportions of the ingredients in the cylinders and beam, were as follows:

Cylinder No. 1 - 1 Cement: 3 sand: 9 Broken Stone.
Cylinder No. 2 - 1 Cement: 2 Sand: 4 Broken Stone.
Cylinder No. 3 - 1 Cement: 3 Sand: 6 Broken Stone.
Beam - 1 Cement: 3 Sand: 6 Broken Stone.

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In referring to the cylinders hereafter they will be known as Cylinders No. 1, 2, or 3 as the case may be.

The cylinders were each four feet high by fifteen inches in diameter. When the cylinders were made, holes were formed in them extending from one end to the center. Into these holes, wooden sticks of sufficient size to insure a fairly snug fit, were inserted. The thermometers were fastened, in grooves in these sticks which were provided for them. This method of placing the thermometers in the cylinders was adopted in order to obtain as nearly as possible the true temperature of the concrete. The wood being a poor conductor of heat and fitting snugly in the hole, the thermometers were consequently influences only by the temperature variations in the concrete. A diagram of one of the cylinders is shown in figure 3 page 8 .

The cylinders were first located on the north side of the East wing of the Engineering Building, but it was found that the sun shining on them in the morning, caused variations in the readings, due to the radiant heat, that affected the variations due to atmospheric changes in the temperature. In order to prevent these variations due to the direct exposure of the sun, the cylinders were placed in the court at the east end of the Engineering Building. In this position the specimens were in the shadow of the building during the entire day.

The concrete beam was six feet four inches long, one foot wide, and one foot two inches high. It was closely wrapped with a two inch layer of felt with the exception of one end, which was left exposed. By this arrangement the heat could enter only at one end.

Seven thermometers were placed at intervals along the top of the beam in holes which were just large enough to admit them, and which were six inches in depth.

Suitable protection from the weather was afforded the thermometers in all the specimens. A sketch of the beam is given in figure 4 , page 8 .

A test was also conducted on a small concrete culvert of the Illinois Central Railroad. A two inch iron pipe was placed at an angle, in the earth filling on the top of the culvert with its lower end resting on the arch. A wooden pole of the same length and approximately the same size was placed inside the pipe, and a minimum recording thermometer fastened to its end. Observations were taken at intervals of a week or more and from these results a curve has been plotted showing graphically the variations of the temperature at the crown of the arch with respect to that of the air. The manner in which the thermometer was placed in the culvert is shown by figure 5 , page 8 .

Discussion of the Results.

The readings of the thermometers for the cylinders are given on pages 9-23 inclusive, and for the beam on pages 24-28 inclusive. The relation between the temperatures of the concrete and of the air for these readings can be seen from the curves which are shown on pages 30-117 inclusive. The most noticeable fact is the manner in which the temperature of the concrete lags behind that of the air which is due to the fact that the concrete has a greater specific heat and a greater density than the air.

It has already been explained that the three cylinders are

of different mixtures of concrete; but by comparing the data and curves for each of these cylinders, with those of the other two, it is seen that the difference in composition makes but a slight difference in the thermal conductivity of the concrete. In a coarser mixture there might be a greater difference since there would be a greater percent of voids.

The temperatures of the concrete for periods during which no observations were made, were estimated by noting the lag in the temperature variations for the periods during which readings were taken, and by estimating the probable lag for other periods. In a number of cases the estimated values were checked by actual readings, and the resulting errors were found to be less than one degree for most of the results, although in a few cases there was an error of about four degrees.

7?

Figures 1 and 2, page 8, have been drawn to illustrate the manner in which the temperature of a mass of concrete varies. Figure 2 represents the section of the concrete beam, the side on which the temperature scale is shown being the exposed surface. Figure 1 represents the air temperature curve. The data used for these figures is that taken for the beam on February 26 and 27. For any particular time the temperature at the surface of the concrete will be very nearly the same as that of the air. The data sheet for the beam gives the corresponding temperature for the concrete at points 7, 13, 25, 37, and 50 inches from the end. Connecting the points representing the readings, taken at a given time, a curve such as "a" figure 2 is obtained. Curves "b", "c", "d", etc., were obtained by connecting similar sets of observations. These curves show graph-

ically the way in which the flow of heat in concrete occurs. It is noticeable that while the temperature variations of the concrete near the surface is very nearly as great as that of the air, at a short distance inside the fluctuation decreases and a point is finally reached where the temperature remains practically constant. Therefore, a large mass of concrete, will have a uniformly varying temperature, being affected only by the annual variation in the air temperature. During the year the air varies between two mean temperatures reaching a maximum in summer, and a minimum in winter. The temperature of the concrete will act in the same way, but in a lesser degree. Thus a short time after the temperature of the air reaches its maximum point in the summer, the temperature of the concrete will reach its maximum point; and in the winter the temperature of the concrete will reach its minimum point a short time after the air temperature reaches its minimum value. From the results obtained in the experiments described, the writer believes that for large masses of concrete the effect of the daily variations in the air temperature may be neglected for all material which is at a greater distance than seven inches from an exposed surface.

The writer has assumed that the annual variations of the temperature of the air is between 100° Fahrenheit for a maximum, and 20° below zero for a minimum. By averaging the difference between the temperature of the air and the temperature of the concrete as obtained from the results, it is found that the temperature of the concrete cylinder is 6.26° Fahrenheit below that of the air, and that of the beam is 7.36° Fahrenheit below the temperature of the air. It is probable that for the maximum temperature assumed for

the air, as stated above, the concrete in exposed structures, having a thickness comparable to the specimens tested, would have a maximum temperature of about 92° Fahrenheit, and a minimum temperature of about -12° Fahrenheit. These values appear to be substantiated by the results which the writer obtained from the experiment conducted on the concrete culvert. By observing the values tabulated for the culvert it will be noticed that the variations between the air temperatures and the temperature of the concrete agree closely with the values that have been deduced from the above.

Therefore, the writer believes that for concrete structures such as floors, walls, bridges with open spandrels, and similar structures, the daily variations in the temperature of the air would have to be taken into consideration in the computation of the temperature stresses; and the variation in the temperature of the concrete would be nearly as great as that of the air. But for structures such as abutments, retaining walls and others which are comparable to the beam, in that only a small surface is exposed, the effect of the daily variations in the air temperature may be neglected and only the annual variation need be considered.

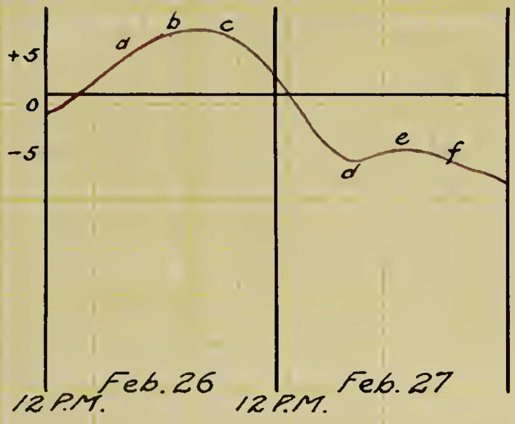


Fig. 1.

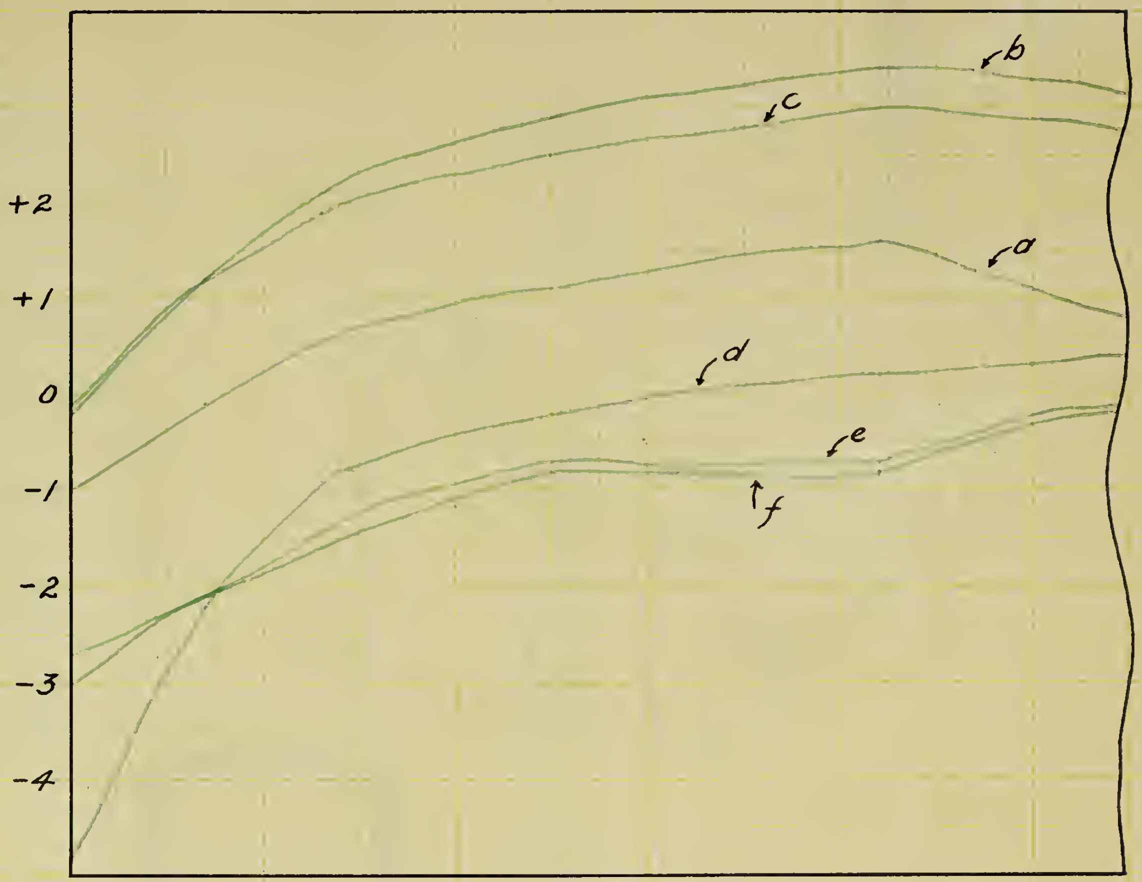
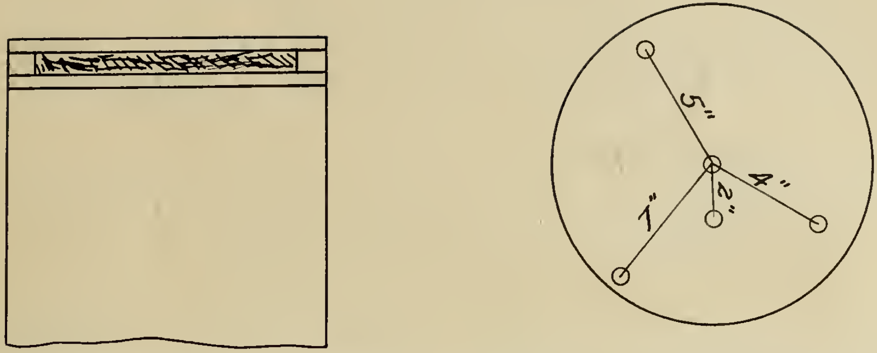


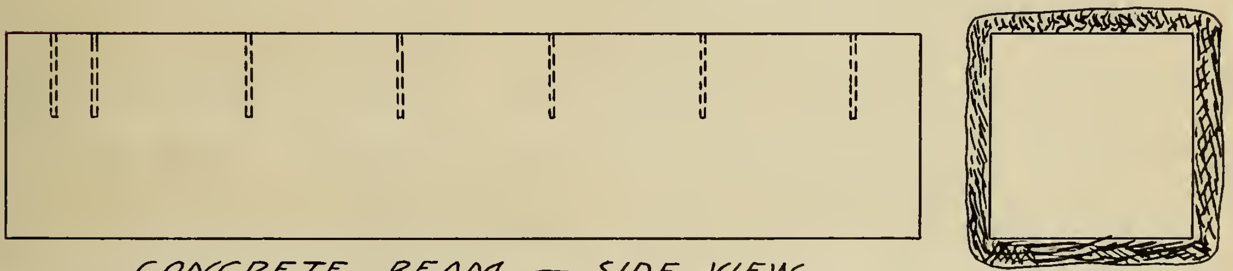
Fig. 2.



PLAN OF CYLINDERS SHOWING COVERING.

PLAN SHOWING POSITION OF THERMOMETERS.

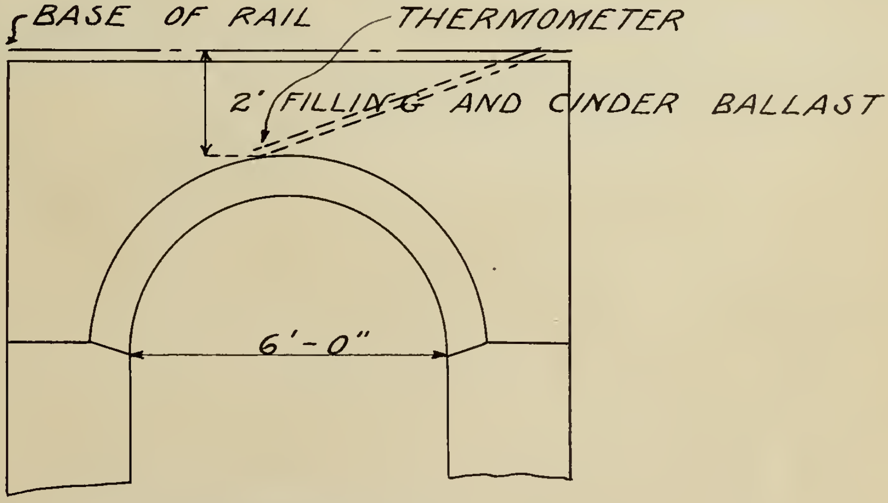
Fig. 3.



CONCRETE BEAM — SIDE VIEW

END VIEW

Fig. 4.


BASE OF RAIL
THERMOMETER
2' FILLING AND CINDER BALLAST
6'-0"

CULVERT

Fig. 5.

DATA FOR CONCRETE CYLINDER NO. 1.

Proportions of Concrete: 1 Cement: 3 Sand: 9 Broken Stone.

Date	Hour	Temp. of Air	Temperature of Concrete.				
			Distance from Center of Cylinder, inches.				
			0	2	4	6	7
Dec 18	8:00 A.M.	+1.5	+1.5	+1.3	+1.3	+1.5	+1.2
	12:00 M.	+6.0	+2.0	+3.2	+3.2	+3.0	+3.0
	5:00 P.M.	+4.5	+2.3	+2.3	+2.3	+2.8	+2.6
Dec 19	8:00 A.M.	-0.8	+1.0	+1.1	+1.0	+1.2	+1.0
	12:00 M.	+0.4	+1.2	+1.2	+1.3	+1.5	+1.2
	5:00 P.M.	-1.0	+1.3	+0.5	+0.5	+1.2	+1.1
Dec 20	8:00 A.M.	+1.3	+0.3	-1.2	-1.2	+0.5	+0.5
	12:00 M.	+5.0	+2.2	+0.2	+0.2	+2.6	+2.6
	5:00 P.M.	+4.6	+2.6	+2.0	+2.0	+2.5	+2.5
Dec 23	8:00 A.M.	-1.0	+1.0	-1.9	-1.7	+1.5	+1.0
	12:00 M.	+1.5	+3.0	+3.0	+2.8	+2.5	+2.5
	5:00 P.M.	-0.5	+0.5	+2.0	+2.1	+0.5	+0.3
Dec 22	8:00 A.M.	-0.5	+1.0	+1.0	+1.1	+1.0	+1.0
	12:00 M.	0.0	+1.0	+1.3	+1.4	+1.0	+1.0
	5:00 P.M.	-0.5	+1.0	+1.0	+1.2	+0.5	+0.3
Feb 12	8:00 A.M.	-1.2	-2.0	-2.0	-2.1	-1.9	-1.8
	12:00 M.	+7.1	-L.5	-1.4	-1.3	-1.1	-1.2
	5:00 P.M	+4.4	-0.6	+0.2	+0.3	-1.0	+1.6

DATA FOR CONCRETE CYLINDER NO. 1.

Proportions of Concrete: 1 Cement: 3 Sand: 9 Broken Stone.

Date	Hour	Temp. of Air.	Temperature of Concrete.				
			Distance from Center of Cylinder, inches.				
			0	2	4	6	7
Feb 13	8:00 A.M.	+3.6	-2.6	+2.6	+2.5	+2.8	+2.8
	12:00 M.	+5.6	-3.4	+3.6	+3.7	+2.8	+4.0
	5:00 P.M.	+6.6	+0.6	+5.0	+5.0	+5.0	+5.4
Feb 14	8:00 A.M.	-7.8	-0.3	-1.4	-0.6	-0.8	-0.8
	12:00 M.	-6.3	-2.6	-2.8	-2.8	-3.2	-3.4
	5:00 P.M.	-6.4	-3.8	-3.8	-3.9	-4.0	-4.0
Feb 15	8:00 A.M.	-12.0	-8.0	-8.2	-8.2	-8.2	-8.2
	12:00 M.	-8.3	-8.2	-8.5	-8.5	-8.3	-8.4
	5:00 P.M.	-6.4	-7.4	-7.6	-7.8	-7.2	-7.2
Feb 16	8:00 A.M.	-11.2	-8.4	-8.8	-8.7	-8.7	-8.7
	12:00 M.	-5.4	-8.2	-8.4	-8.7	-8.0	-7.9
	5:00 P.M.	-2.6	-6.0	-6.0	-6.1	-5.6	-5.3
Feb 19	8:00 A.M.	+1.2	+1.0	+1.5	+1.3	+0.5	+0.6
	12:00 M.	+8.2	+2.0	+2.1	+2.3	+2.5	+3.0
	5:00 P.M.	+8.8	+5.6	+5.6	+5.7	+6.2	+6.6
Feb 20	8:00 A.M.	+6.2	+6.2	+5.3	+6.2	+6.2	+6.2
	12:00 M.	+14.9	+8.0	+8.0	+8.6	+8.6	+9.0
	5:00 P.M.	+13.2	+10.1	+10.2	+10.2	+10.4	+10.6

DATA FOR CONCRETE CYLINDER NO. 1.

Proportions of Concrete: 1 Cement: 3 Sand: 9 Broken Stone.

Date	Hour	Temp of Air	Temperature of Concrete.				
			Distance from Center of Cylinder, inches				
			0	2	4	6	7
Feb 21	8:00 A.M.	+2.0	+5.2	+5.3	+5.3	+5.4	+4.8
	12:00 M.	+2.7	+4.4	+4.6	+4.6	+4.1	+4.4
	5:00 P.M.	+2.8	+4.3	+4.4	+4.5	+4.0	+4.3
Feb 22	8:00 A.M.	+0.1	+1.2	+1.3	+1.3	+1.2	+1.4
	12:00 M	+7.1	+2.0	+2.0	+2.1	+2.5	+2.8
	5:00 P.M.	+9.2	+6.0	+6.0	+6.0	+6.6	+6.9
Feb 23	8:00 A.M.	+6.6	+5.5	+5.6	+5.6	+5.5	+5.8
	12:00 M.	+8.6	+6.6	+6.8	+6.3	+6.4	+5.6
	5:00 P.M.	+7.2	+6.4	+6.3	+6.3	+5.0	+5.6
Feb 26	8:00 A.M.	-1.0	-0.5	-0.9	-0.8	-0.5	-0.3
	12:00 M.	-0.2	-0.0	-0.0	-0.1	-0.1	0.0
	5:00 P.M.	-0.1	-0.2	0.0	0.0	-0.3	-0.2
Feb 27	8:00 A.M.	-4.8	-2.6	-2.7	-2.8	-2.8	-2.9
	12:00 M.	-2.7	-3.0	-3.0	-3.1	-2.6	-2.8
	5:00 P.M.	-3.0	-3.5	-2.3	-2.4	-2.7	-2.5
Feb 28	8:00 A.M.	-3.0	-4.2	-4.2	-4.4	-3.6	-3.4
	12:00 M.	-1.1	-3.8	-3.9	-3.9	-3.3	-3.4
	5:00 P.M.	-0.8	-2.0	-1.9	-2.0	-1.4	-1.6

DATA FOR CONCRETE CYLINDER NO. 1.

Proportions of COncrete: 1 Cement: 3 Sand: 9 Broken Stone.

Date	Hour	Temp. of Air.	Temperature of Concrete.				
			Distance from Center of Cylinder, inches				
			0	2	4	6	7
Mar 1	8:00 A.M.	+2.6	-1.2	-1.1	-1.1	-0.8	-0.8
	12:00 M.	+6.3	-6.6	-0.4	-0.4	-0.2	-0.2
	5:00 P.M.	-8.0	+3.0	+3.2	+3.2	+3.6	+3.6
Mar 7	8:00 A.M.	+1.8	+1.4	+1.6	+1.6	+1.6	+1.7
	12:00 M.	+2.8	+1.8	+2.0	+2.0	+1.9	+2.2
	5:00 P.M.	+5.2	+3.2	+3.2	+3.2	+3.4	+3.6
Mar 8	8:00 A.M.	+1.8	+2.6	+2.8	+2.8	+2.4	+2.8
	12:00 M.	+4.0	+2.8	+3.0	+3.1	+2.8	+3.2
	5:00 P.M.	+7.6	+4.6	+4.7	+4.7	+5.8	+5.1
Mar 9	8:00 A.M.	+1.4	+2.2	+1.3	+1.4	+2.3	+2.3
	12:00 M.	+4.4	+3.2	+3.4	+3.5	+3.3	+3.6
	5:00 P.M.	+2.5	+2.9	+2.6	+2.6	+2.8	+2.9
Mar 20	8:00 A.M.	-10.2	-7.2	-8.6	-8.7	-4.5	-4.5
	12:00 M.	-6.8	-6.8	-4.0	-4.1	-4.3	-4.3
	5:00 P.M.	-6.3	-6.5	-3.5	-3.6	-4.8	-4.8
Mar 21	8:00 A.M.	-5.0	-5.3	-8.3	-8.4	-4.9	-4.9
	12:00 M.	+2.2	-5.4	-5.4	-5.4	-4.4	-4.4
	5:00 P.M.	-4.8	-5.3	-6.2	-6.3	-4.8	-4.8

DATA FOR CONCRETE CYLINDER NO. 1.

Proportions of Cement: 1 Cement: 3 Sand: 9 Broken Stone.

Date	Hour	Temp. of Air	Temperatureof Concrete.				
			Distance from Center of Cylinder, Inches				
			0	2	4	6	7
Mar 22	8:00 A.M.	-10.2	-6.2	-9.0	-9.0	-8.0	-7.9
	12:00 M.	-6.1	-6.4	-6.4	-6.5	-6.4	-6.4
	5:00 P.M.	-4.8	-5.3	-5.4	-5.5	-5.2	-5.2
Mar 23	8:00 A.M.	-5.2	-6.2	-6.4	-6.5	-6.2	-6.1
	12:00 M.	-1.6	-4.9	-5.0	-5.1	-4.7	-4.6
	5:00 P.M.	-1.4	-3.2	-3.3	-3.4	-3.2	-3.0
Mar 26	8:00 A.M.	+8.2	=4.8	+2.0	+2.1	+2.3	+2.4
	12:00 M.	+9.2	+5.2	+4.9	+4.9	+5.3	+4.8
	5:00 P.M.	+4.6	+4.4	+4.5	+4.7	+3.0	+2.8
Mar 27	8:00 A.M.	+3.1	+4.2	+4.4	+4.5	+4.9	+4.0
	12:00 M.	+4.4	+3.8	+3.9	+4.0	+3.5	+3.6
	5:00 P.M.	+3.4	+3.8	+3.9	+4.0	+3.4	+3.6
Mar 28	8:00 A.M.	+0.8	+1.6	+1.7	+1.7	+1.4	+1.6
	12:00 P.M.	+2.0	+1.5	+1.6	+1.6	+1.2	+1.5
	5:00 P.M.	+1.0	+1.3	+1.5	+1.5	+1.0	+1.3

DATA FOR CONCRETE CYLINDER NO. 2.

Proportions of Cement: 1 Concrete: 2 Sand: 4 Broken Stone.

Date	Hour	Temp. of Air.	Temperature of Concrete. Distance from Center of Cylinder, inches. 0	2	4	6	7
Dec 18	8:00 A.M.	+1.5	+1.2	+1.4	+1.3	+1.5	+1.4
	12:00 M.	+6.0	+3.2	+3.1	+3.2	+3.2	+3.2
	5:00 P.M.	+4.5	+3.2	+2.3	+2.2	+2.5	+2.8
Dec 19	8:00 A.M.	-0.8	+1.1	+1.1	+1.2	+1.2	+1.2
	12:00 M.	+o.4	+1.2	+1.3	+1.2	+1.5	+1.2
	5:00 P.M.	-1.0	+1.1	+0.4	+0.5	+1.2	+1.2
Dec 20	8:00 A.M.	+1.3	+1.3	+0.1	+0.2	+1.2	+1.2
	12:00 M.	+5.0	+0.2	+1.2	+2.5	+0.6	+2.1
	5:00 P.M.	+4.6	+1.8	+1.4	+1.0	+2.4	+2.4
Dec 21	8:00 A.M.	-1.0	+1.0	-0.2	-0.1	+1.1	+1.1
	12:00 M.	+1.5	+2.7	+2.5	+2.6	+2.8	+2.4
	5:00 P.M.	-0.5	+1.1	+1.1	+1.3	+1.0	+1.1
Dec 22	8:00 A.M.	-0.5	+1.1	+1.1	+1.1	+1.2	+1.0
	12:00 M.	0.0	+1.1	+1.0	+1.5	+1.1	+1.0
	5:00 P.M.	-0.5	+1.1	+1.1	+1.0	+1.3	+1.2
Feb 12	8:00 A.M.	-1.2	-2.0	-2.6	-5.5	-1.8	-1.7
	12:00 M.	+7.1	-0.8	-1.6	-1.3	-0.8	-0.8
	5:00 P.M.	+4.4	-0.6	-0.6	-0.6	-1.5	-1.5

DATA FOR CONCRETE CYLINDER NO. 2.

Proportions of Cement: 1 Concrete: 2 Sand: 4 Broken Stone.

Date	Hour	Temp. of Air.	Temperature of Concrete.				
			Distance from Center of Cylinder, inches.				
			0	2	4	6	7
Feb 13	8:00 A.M.	+3.6	+2.4	+2.3	+2.5	+2.7	+2.7
	12:00 M.	+5.6	+3.2	+3.2	+3.4	+3.8	+3.8
	5:00 P.M.	+6.6	+4.7	+4.7	+4.8	+5.0	+5.2
Feb 14	8:00 A.M.	-7.8	-0.3	-0.8	-5.6	-0.2	-0.6
	12:00 M.	-6.3	-1.1	-1.8	-1.5	-2.0	-2.8
	5:00 P.M.	-6.4	-3.0	-3.0	-3.0	-3.0	-3.4
Feb 15	8:00 A.M.	-12.0	-7.8	-7.9	-8.0	-8.0	-8.0
	12:00 M.	-8.3	-8.2	-8.2	-8.1	-8.0	-8.0
	5:00 P.M.	-6.4	-7.4	-7.3	-7.2	-7.0	-6.7
Feb 16	8:00 A.M.	-11.2	-8.2	-8.3	-8.4	-8.2	-8.3
	12:00 M.	-5.4	-8.2	-8.0	-8.0	-7.6	-7.5
	5:00 P.M.	-2.6	-6.0	-6.0	-5.8	-5.4	-5.4
Feb 19	8:00 A.M.	+5.2	+0.3	+0.3	+1.5	+0.4	+3.3
	12:00 M.	+8.2	+1.9	+1.8	+2.2	+2.6	+3.0
	5:00 P.M.	+8.8	+5.4	+4.5	+5.6	+6.0	+6.6
Feb 20	8:00 A.M.	+7.6	+6.2	+6.1	+6.2	+6.4	+6.4
	12:00 M.	+14.9	+7.7	+7.7	+8.0	+8.5	+8.9
	5:00 P.M.	+13.2	+9.9	+10.0	+10.0	+10.3	+10.6

DATA FOR CONCRETE CYLINDER NO. 2.

Proportions of Cement: 1 Cement: 2 Sand: 4 Broken Stone.

Date	Hour.	Temp. of Air.	Temperature of Concrete.				
			Distance from Center of Cylinder, inches.				
			0	2	4	6	7
Feb 21	8:00 A.M.	+2.0	+5.5	+5.3	+5.4	+5.3	+4.8
	12:00 M.	+2.7	+4.7	+4.6	+4.7	+4.8	+4.5
	5:00 P.M.	+2.8	+4.4	+4.3	+4.5	+4.6	+4.2
Feb 22	8:00 A.M.	+0.1	+1.7	+1.5	+1.6	+1.7	+1.5
	12:00 M.	+7.1	+2.1	+2.1	+2.5	+2.8	+3.2
	5:00 P.M.	+9.2	+5.8	+5.9	+5.8	+6.5	+7.0
Feb 23	8:00 A.M.	+6.6	+5.8	+5.6	+5.8	+5.8	+5.8
	12:00 M.	+8.6	+6.4	+6.5	+6.5	+6.8	+6.9
	5:00 P.M.	+7.2	+6.2	+6.8	+6.8	+6.3	+6.4
Feb 26	8:00 A.M.	-1.0	0.0	0.0	-0.8	0.0	-0.1
	12:00 M.	-0.2	+0.1	0.0	+0.1	+0.2	+0.2
	5:00 P.M.	-0.1	0.0	0.0	0.0	0.0	-0.1
Feb 27	8:00 A.M.	-4.8	-2.7	-2.1	-2.2	-2.0	-2.1
	12:00 M.	-2.7	-2.6	-2.6	-2.5	-2.4	-2.5
	5:00 P.M.	-3.0	-2.8	-2.4	-2.4	-2.2	-2.2
Feb 28	8:00 A.M.	-3.0	-4.6	-4.2	-4.7	-4.7	-2.2
	12:00 M.	-1.1	-3.8	-3.8	-3.9	-3.3	-3.2
	5:00 P.M.	-0.8	-2.0	-2.0	-2.1	-1.6	-1.6

DATA FOR CONCRETE CYLINDER NO. 2.

Proportions of Concrete: 1 Cement: 2 Sand: 4 Broken Stone.

Date	Hour	Temp. of Air.	Temperature of Concrete.				
			Distance from Center of Cylinder, inches.				
			0	2	4	6	7
Mar 1	8:00 A.M.	+2.6	-1.2	-1.2	-1.3	-0.8	-0.8
	12:00 M.	+6.3	-0.7	-0.7	-0.7	-0.2	-0.1
	5:00 P.M.	+8.0	+2.2	+2.3	+2.2	+3.0	+3.0
Mar 7	8:00 A.M.	+1.8	+1.3	+1.3	+1.3	+1.6	+1.5
	12:00 P.M.	+2.8	+1.7	+1.7	+1.7	+2.0	+2.0
	5:00MP.M.	+5.2	+2.9	+3.0	+3.0	+3.3	+3.4
Mar 8	8:00 A.M.	+1.8	+2.6	+2.5	+2.5	+2.6	+2.4
	12:00 M.	+4.0	+2.7	+2.7	+2.8	+3.0	+2.8
	5:00 P.M.	+7.6	+4.3	+5.3	+4.4	+4.7	+4.8
Mar 9	8:00 A.M.	+1.4	+1.8	+1.9	+1.9	+1.8	+1.8
	12:00 M.	+4.4	+3.4	+3.4	+3.4	+3.4	+3.4
	5:00 P.M.	+2.5	+2.7	+2.8	+2.8	+2.6	+2.6
Mar 20	8:00 A.M.	-10.2	-9.6	-9.4	-9.2	-9.8	-9.9
	12:00 M.	-6.8	-8.6	-8.5	-8.4	-8.4	-8.6
	5:00 P.M.	-6.3	-8.3	-8.1	-8.1	-8.3	-8.4
Mar 21	8:00 A.M.	-5.2	+1.0	+1.0	+1.0	+1.3	+1.4
	12:00 M.	+2.2	+5.6	+5.6	+5.7	+4.8	+4.2
	5:00 P.M.	-4.8	+1.7	+1.6	+1.6	+1.7	+1.7

DATA FOR CONCRETE CYLINDER NO. 2.

Proportions of Concrete: 1 Cement: 2 Sand: 4 Broken Stone.

Date	Hour.	Temp. of Air	Temperature of Concrete.				
			Distance from Center of Cylinder.				
			0	2	4	6	7
Mar 22	8:00 A.M.	-10.2	-8.6	-8.9	-8.8	-8.5	-8.6
	12:00 M.	-6.1	-6.9	-6.8	-6.9	-6.8	-7.8
	5:00 P.M.	-4.8	-6.0	-5.9	-5.8	-6.0	-6.0
Mar 23	8:00 A.M.	-5.2	-6.5	-6.5	-6.7	-6.8	-6.8
	12:00 M.	-1.6	-5.3	-5.3	-5.4	-5.1	-5.2
	5:00 P.M.	-1.4	-3.9	-2.7	-3.9	-3.9	-3.7
Mar 26	8:00 A.M.	+6.2	+2.2	+2.8	+3.3	+2.3	+2.3
	12:00 M.	:9.2	+4.2	+4.4	+5.0	+4.8	+5.6
	5:00 P.M.	+4.6	+3.8	+4.9	+4.2	+2.7	+4.0
Mar 27	8:00 A.M.	+3.1	+4.3	+4.1	+4.0	+4.2	+3.8
	12:00 M.	+4.4	+3.6	+3.5	+3.5	+3.7	+3.4
	5:00 P.M.	+3.4	+4.4	+3.3	+3.5	+4.5	+3.2
Mar 28	8:00 A.M.	+0.8	+1.6	+1.5	+1.4	+1.5	+1.4
	12:00 M.	+2.0	+1.3	+1.3	+1.4	+1.3	+1.2
	5:00 P.M.	+1.0	+1.2	+1.2	+1.4	+1.3	+1.4

DATA FOR CONCRETE CYLINDER NO. 3.

Proportions of Concrete: 1 Cement: 3 Sand: 6 Broken Stone.

Date	Hour	Temp. of Air.	Temperature of Concrete.				
			Distance from Center of Cylinder, inches				
			0	2	4	6	8
Dec 18	8:00 A.M.	+1.5	+1.6	+1.5	+1.6	+1.6	+1.6
	12:00 M.	+6.0	+3.L	+3.5	+4.1	+4.1	+4.3
	5:00 P.M.	+4.5	+2.5	+2.4	+2.6	+2.7	+3.0
Dec 19	8:00 A.M.	-0.8	+1.5	+1.4	+1.5	+1.5	+1.4
	12:00 M.	+0.4	+1.6	+1.5	+1.9	+1.5	+1.5
	5:00 P.M.	-1.0	+1.3	+1.4	+1.6	+1.6	+1.4
Dec 20	8:00 A.M.	+1.3	+0.3	+0.7	+0.3	+0.3	+1.2
	12:00 M.	+5.0	+0.9	+2.2	+1.0	+1.5	+1.4
	5:00 P.M.	+4.6	+1.8	+1.5	+2.0	+2.3	+2.5
Dec 21	8:00 A.M.	-1.0	+1.1	+1.4	+1.3	+1.1	+1.1
	12:00 M.	+1.5	+3.0	+3.0	+3.0	+3.1	+2.8
	5:00 P.M.	-0.5	+1.2	+2.8	+1.6	+1.2	+1.3
Dec 22	8:00 A.M.	-0.5	+1.4	+1.4	+1.6	+1.8	+1.4
	12:00 M.	0.0	+1.6	+1.8	+1.8	+2.0	+2.0
	5:00 P.M.	-0.5	+1.4	+1.4	+1.6	+1.4	+1.6
Feb 12	8:00 A.M.	-1.2	-1.9	-2.0	-1.5	-1.6	-1.9
	12:00 M.	+7.1	-0.8	-1.1	-1.1	-0.8	-0.8
	5:00 P.M.	+4.4	0.0	-0.5	-0.4	+1.2	0.0

DATA FOR CONCRETE CYLINDER NO. 3.

Proportions of Concrete: 1 Cement: 3 Sand: 6 Broken Stone.

Date	Hour	Temp. of Air.	Temperature of Concrete.				
			Distance from Center of Cylinder, inches				
			0	2	4	6	8
Feb 13	8:00 A.M.	+3.6	+2.3	+2.5	+2.7	+2.8	+3.0
	12:00 M.	+5.6	+3.4	+3.4	+3.6	+3.8	+3.9
	5:00 P.M.	+6.6	+5.4	+5.0	+5.2	+5.2	+5.2
Feb 14	8:00 A.M.	-7.8	0.0	-0.7	-0.2	-0.2	-0.7
	12:00 M.	-6.3	-2.8	-2.7	-2.6	-2.0	-2.8
	5:00 P.M.	-6.4	-3.5	-3.5	-2.8	-2.8	-3.5
Feb 15	8:00 A.M.	-12.0	-9.0	-9.0	-7.2	-7.1	-9.0
	12:00 M.	-8.3	-9.0	-9.0	-7.8	-7.5	-9.0
	5:00 P.M.	-6.4	-7.0	-7.0	-6.4	-6.8	-7.0
Feb 16	8:00 A.M.	-8.4	-8.4	-7.4	-7.4	-7.4	-8.4
	12:00 M.	-7.4	-7.8	-8.7	-7.3	-7.2	-7.8
	5:00 P.M.	-2.6	-5.3	-5.3	-5.2	-5.2	-5.3
Feb 19	8:00 A.M.	+5.2	+1.8	+0.7	+1.6	+1.9	+2.0
	12:00 M.	+8.2	+3.4	+2.0	+2.4	+2.8	+3.4
	5:00 P.M.	+8.8	+6.6	+6.0	+5.8	+5.8	+6.6
Feb 20	8:00 A M.	+7.6	+6.6	+6.0	+6.5	+6.5	+6.6
	12:00 M.	+14.9	+9.1	+8.5	+8.0	+6.3	+9.0
	5:00 P.M.	+13.2	+10.5	+10.0	+10.0	+10.0	+10.2

DATA FOR CONCRETE CYLINDER NO. 3.

Proportions of Concrete: 1 Cement: 3 Sand: 6 Broken Stone.

Date	Hour	Temp. of Air.	Temperature of Concrete.				
			Distance from Center of Cylinder, inches.				
			0	2	4	6	8
Feb 21	8:00 A.M.	+2.0	+5.2	+5.2	+5.8	+5.1	+5.2
	12:00 M.	+2.7	+4.9	+4.8	+5.0	+5.2	+4.9
	5:00 P.M.	+2.8	+4.5	+4.3	+4.8	+4.9	+4.6
Feb 22	8:00 A.M.	+0.1	+2.1	+2.4	+2.0	+2.4	+2.0
	12:00 M.	+7.1	+3.0	+3.0	+2.8	+3.2	+3.5
	5:00 P.M.	+9.2	+6.3	+5.3	+7.2	+7.2	+7.0
Feb 23	8:00 A.M.	+6.6	+6.1	+6.0	+6.0	+6.2	+6.0
	12:00 M.	+8.6	+7.1	+6.8	+6.8	+7.0	+7.1
	5:00 P.M.	+7.2	+6.5	+6.3	+6.5	+6.5	+7.0
Feb 26	8:00 A.M.	-1.0	+0.1	+0.1	+0.1	0.0	+0.1
	12:00 M.	+0.6	+0.7	+0.6	+0.7	+0.9	-1.0
	5:00 P.M.	-0.1	+0.6	+0.6	+0.6	+0.7	+0.4
Feb 27	8:00 A.M.	-4.8	-3.0	-3.2	-3.2	-3.2	-3.0
	12:00 M.	-2.7	-3.4	-3.4	-3.5	-3.6	-3.4
	5:00 P.M.	-3.0	-3.2	-3.3	-3.2	-3.7	-3.1
Feb 28	8:00 A.M.	-3.0	-3.8	-3.8	-3.8	-3.7	-3.1
	12:00 M.	-1.1	-3.3	-3.3	-3.9	-3.0	-3.3
	5:00 P.M.	-0.8	-1.7	-1.7	-1.3	-1.4	-1.7

DATA FOR CONCRETE CYLINDER NO. 3.

Proportions of Concrete: 1 Cement: 3 Sand: 6 Broken Stone.

Date	Hour	Temp. of Air.	Temperature of Concrete.				
			Distance from Center of Cylinder.				
			0	2	4	6	8
Mar 1	8:00 A.M.	+2.6	-0.9	-0.8	-0.6	-0.8	-0.9
	12:00 M.	+6.3	-0.1	-0.1	+0.4	+0.6	-0.1
	5:00 P.M.	+8.0	+3.9	+3.9	+2.0	+3.2	+3.9
Mar 7	8:00 A.M.	+1.8	+1.9	+1.8	+1.8	+2.0	+1.8
	12:00 M.	+2.8	+2.3	+2.3	+2.2	+2.2	+2.3
	5:00 P.M.	+5.2	+5.1	+3.0	+3.3	+3.6	+2.7
Mar 8	8:00 A.M.	+1.8	-0.8	+2.4	+3.0	+3.2	+2.7
	12:00 M.	+4.0	+3.5	+2.8	+3.2	+3.2	+3.2
	5:00 P.M.	+7.6	+1.2	+4.5	+4.7	+4.8	+5.0
Mar 9	8:00 A.M.	+1.4	+2.0	+1.0	+1.1	+1.2	+2.0
	12:00 M.	+4.4	+3.6	+3.4	+3.8	+3.8	+3.6
	5:00 P.M.	+2.5	+2.3	+2.3	+2.6	+2.4	+2.3
Mar 20	8:00 A.M.	-10.2	-8.5	-9.3	-9.4	-9.3	-9.1
	12:00 M.	-6.8	-5.2	-8.4	-8.3	-8.4	-8.3
	5:00 P.M.	-6.3	-5.0	-8.1	-8.2	-8.3	-7.9
Mar 21	8:00 A.M.	-5.2	-5.0	-4.9	-6.8	-7.9	-1.1
	12:00 M.	+2.2	+4.1	+3.1	+4.3	+4.3	+4.1
	5:00 P.M.	-4.8	-3.3	-1.0	-1.9	+2.3	-0.7

DATA FOR CONCRETE CYLINDER NO. 3.

Proportions of Concrete: 1 Cement: 3 Sand: 6 Broken Stone.

Date	Hour	Temp. of Air.	Temperature of Concrete. Distance from Center of Cylinder, inches.				
			0	2	4	6	8
Mar 22	8:00 A.M.	-10.2	-9.4	-9.3	-9.1	-8.6	-9.0
	12:00 M.	-6.1	-8.1	-8.3	-8.3	-8.3	-8.1
	5:00 P.M.	-4.8	-6.2	-6.2	-6.2	-6.2	-6.1
Mar 23	8:00 A.M.	-5.2	-6.9	-6.9	-7.0	-7.0	-6.9
	12:00 M.	-1.6	-5.3	-5.3	-5.4	-5.5	-5.3
	5:00 P.M.	-1.4	-3.8	-3.8	-3.8	-3.7	-3.7
Mar 26	8:00 A.M.	+6.2	+2.9	+2.8	+2.1	+2.5	+3.1
	12:00 M.	+9.2	+5.5	+5.5	+5.7	+5.6	+5.6
	5:00 P.M.	+4.6	+3.3	+3.8	+3.1	+3.0	+4.2
Mar 27	8:00 A.M.	+3.1	+3.9	+3.9	+4.2	+4.0	+3.8
	12:00 M.	+4.4	+3.4	+3.5	+3.5	+3.6	+3.4
	5:00 P.M.	+3.4	+3.3	+3.3	+3.4	+4.3	+3.3
Mar 28	8:00 A.M.	+0.8	+1.4	+1.3	+1.4	+1.4	+1.5
	12:00 M.	+2.0	+1.2	+1.0	+1.1	+1.0	+1.3
	5:00 P.M.	+1.0	+1.3	+0.9	+1.0	+1.0	+1.4

DATA FOR CONCRETE BEAM.

Date	Air	Distance from End in Inches						
		7	13	25	37	50	61	73
Dec 18th								
8:00 A. M.	+1.5	0.0	+0.5	+0.5	+0.5	+0.5	+0.6	+0.8
12:00 M.	+6.0	+3.5	+1.5	+1.5	+1.3	+2.0	+2.5	+2.6
5:00 P. M.	+4.5	+2.0	+2.0	+0.9	+0.7	+0.6	+0.7	+2.1
Dec 19th								
8:00 A. M.	-0.8	+0.8	+1.0	+1.2	+1.0	+1.0	+1.0	+1.0
12:00 M.	+0.4	+1.5	+1.5	+1.5	+1.2	+1.2	+1.5	+1.4
5:00 P. M.	-1.0	+1.0	+1.0	+1.1	+1.0	+1.0	+1.0	+1.1
Dec 20th								
8:00 A. M.	+1.3	+0.1	+0.2	+0.8	+0.8	+0.8	+0.8	+0.8
12:00 M.	+5.0	+1.0	+1.0	+1.5	+1.3	+1.3	+1.5	+1.4
5:00 P. M.	+4.6	+0.8	+0.8	+1.3	+1.1	+1.1	+1.3	+1.5
Dec 21st								
8:00 A. M.	-1.0	-1.3	-0.3	-0.3	-0.3	-0.3	-0.2	-0.2
12:00 M.	-1.5	+2.5	+2.5	+2.5	+2.5	+2.4	+2.5	+2.5
5:00 P. M.	-0.5	+2.2	+2.2	+2.4	+2.3	+2.3	+2.4	+2.4
Dec 22nd								
8:00 A. M.	-0.5	+1.2	+1.0	+2.0	+2.0	+2.0	+2.0	+2.0
12:00 M.	0.0	+1.8	+2.0	+2.1	+2.3	+2.1	+2.1	+2.0
5:00 P.M.	-0.5	+1.2	+1.3	+2.0	+2.0	+2.0	+2.0	+2.0
Feb 12th								
8:00 A. M.	-1.2	-4.5	-5.0	-5.9	-5.7	-5.8	-5.6	-5.3
12:00 M.	+7.1	-2.1	-3.6	-5.1	-5.0	-5.1	-5.0	-4.5
5:00 P. M.	+4.4	-0.8	-0.6	-4.0	-3.9	-4.0	-4.0	-3.3

BEAM (Continued)

	Air	Distance from End in Inches.						
		7	13	25	37	50	61	73
Feb 13th								
8:00 A. M.	+3.6	0.0	0.0	-1.8	-2.0	-2.0	-1.2	-1.4
12:00 M.	+5.6	-1.2	+0.1	-1.0	-1.2	-1.4	-1.4	-0.6
5:00 P. M.	+6.6	-2.8	-0.1	0.0	-0.4	-0.5	-0.3	+0.3
Feb 14th								
8:00 A. M.	-7.8	-1.6	-0.5	-0.6	-0.9	-0.9	-0.3	-0.3
12:00 M.	-6.3	-3.0	-1.8m	-3.0	-2.0	-1.9	-1.2	-1.2
5:00 P. M.	-6.4	-3.4	-3.0	-2.9	-2.8	-2.4	-2.0	-2.0
Feb 15th								
8:00 A. M.	-12.0	-7.8	-6.5	-5.4	-4.9	-4.8	-4.4	-4.6
12:00 M.	-8.3	-7.5	-7.8	-6.6	-5.0	-4.9	-4.7	-5.0
5:00 P. M.	-6.4	-7.0	-6.5	-5.9	-5.2	-5.1	-5.0	-5.3
Feb 16th								
8:00 A. M.	-11.2	-8.6	-7.5	-6.6	-6.0	-6.0	-5.9	-6.4
12:00 M.	-7.4	-8.2	-7.5	-8.2	-6.0	-6.0	-6.0	-6.3
5:00 P. M.	-2.6	-6.8	-6.8	-6.4	-5.7	-5.8	-5.8	-6.0
Feb 19th								
8:00 A. M.	+5.2	+0.1	-0.3	-0.8	-1.1	-0.7	-0.3	-0.3
12:00 M.	+8.2	+0.6	+0.2	-0.2	-0.2	-0.4	-0.4	-0.2
5:00 P. M.	+8.8	+2.8	+2.6	+0.8	+0.8	+0.5	+0.6	+1.1
Feb 20th								
8:00 A. M.	+7.6	+4.2	+3.6	+2.5	+2.4	+2.2	+2.4	+2.8
12:00 M.	+14.9	+6.3	+4.6	+3.5	+3.3	+3.2	+3.4	+4.0
5:00 P. M.	+13.2	+7.9	+6.2	+4.6	+4.4	+4.3	+4.5	+5.3

BEAM (Continued)

Date	Air	Distance from End in Inches.						
		7	13	25	37	50	61	73
Feb 21st								
8:00 A. M.	+2.0	+4.6	+5.4	+5.1	+4.8	+4.5	+4.7	+4.7
12:00 M.	+2.7	+4.4	+4.9	+4.8	+4.6	+4.4	+4.6	+4.5
5:00 P. M.	+2.8	+4.2	+4.5	+4.3	+4.3	+4.2	+4.3	+4.3
Feb 22nd								
8:00 A. M.	+0.1	+1.8	+2.7	+3.3	+3.4	+3.2	+3.2	+2.9
12:00 M.	+7.1	+2.5	+2.6	+3.2	+3.4	+3.3	+3.2	+3.1
5:00 P. M.	+9.2	+4.7	+3.9	+3.7	+4.0	+3.9	+3.8	+4.0
Feb 23rd								
8:00 A. M.	+6.6	+4.3	+4.4	+4.2	+4.2	+4.2	+4.2	+4.2
12:00 M.	+8.6	+5.4	+4.8	+4.4	+4.5	+4.5	+4.5	+4.6
5:00 P. M.	+7.2	+4.8	+4.5	+4.5	+4.3	+4.6	+4.3	+4.4
Feb 26th								
8:00 A. M.	-1.0	-0.1	+0.6	+1.1	+1.6	+1.1	+2.3	+2.3
12:00 M.	-0.2	+1.2	+2.1	+2.9	+3.4	+3.3	+3.2	+2.8
5:00 P. M.	-0.1	+1.2	+1.9	+2.5	+3.0	+2.9	+2.7	+2.4
Feb 27th								
8:00 A. M.	-4.8	-2.2	-0.9	-0.2	+0.2	+0.3	+0.5	+0.2
12:00 M.	-2.7	-2.1	-1.4	-0.7	-0.7	-0.2	0.0	-0.1
5;00 P. M.	-3.0	-2.1	-1.6	-0.8	-0.8	-0.3	-0.5	-0.5
Feb 28th								
8:00 A. M.	-3.0	-2.1	-1.6	-0.8	-2.2	-2.5	-3.1	-3.2
12:00 M.	-1.1	-3.5	-3.2	-2.4	-1.8	-1.8	-1.8	-2.1
5:00 P. M.	-0.8	-2.1	-2.4	-2.3	-2.6	-1.6	-1.7	-1.7

BEAM (Continued)

Date	Air	Distance from End in Inches.						
		7	13	25	37	50	61	73
March 1st								
8:00 A. M.	+2.6	-1.8	-1.8	-1.9	-1.5	-1.5	-1.4	-1.5
12:00 M.	+6.3	-0.4	-1.0	-1.5	±1.0	-1.1	-1.1	-1.0
5:00 P. M.	+8.0	+1.8	+0.5	-0.5	-0.2	-0.2	-0.3	+0.2
March 7th								
8:00 A. M.	+1.8	+1.3	+1.4	+1.2	+1.3	+1.2	+1.2	+1.3
13:00 M.	+2.8	+1.8	+1.7	+1.4	+1.6	+1.5	+1.4	+1.5
5:00 P. M.	+5.2	+2.8	+2.4	+1.8	+2.0	+1.9	+2.0	+2.0
March 8th								
8:00 A. M.	+1.8	+2.4	+2.6	+2.4	+2.5	+2.3	+3.4	+2.4
12:00 M.	+4.0	+2.7	+2.7	+2.5	+2.6	+2.5	+2.5	+2.5
5:00 P. M.	+7.6	+4.2	+3.5	+3.0	+3.2	+3.0	+3.0	+3.2
March 9th								
8:00 A. M.	+1.4	+0.9	+1.3	+1.1	+1.1	+1.1	+3.1	+3.2
12:00 M.	+4.4	+3.4	+3.4	+3.4	+3.4	+3.4	+3.4	+3.4
5:00 P. M.	+2.5	+2.5	+2.6	+2.8	+2.8	+3.9	+3.2	+3.2
March 20th								
8:00 A. M.	-10.2	-5.8	-4.2	-3.6	-3.6	-3.8	-3.8	-4.0
12:00 M.	-6.8	-5.6	-5.6	-3.8	-3.8	-3.8	-4.0	-4.1
5:00 P. M.	-6.3	-5.6	-5.0	-3.6	-3.6	-3.8	-4.0	-4.1
March 21st								
8:00 A. M.	-5.2	-6.3	-5.8	-4.6	-4.1	-4.2	-4.4	-4.6
13:00 M.	+2.2	-3.8	-4.6	-4.6	-3.8	-3.9	-4.0	-4.1
5:00 P. M.	-4.8	-4.7	-4.8	-4.6	-3.9	-3.7	-4.2	-4.2

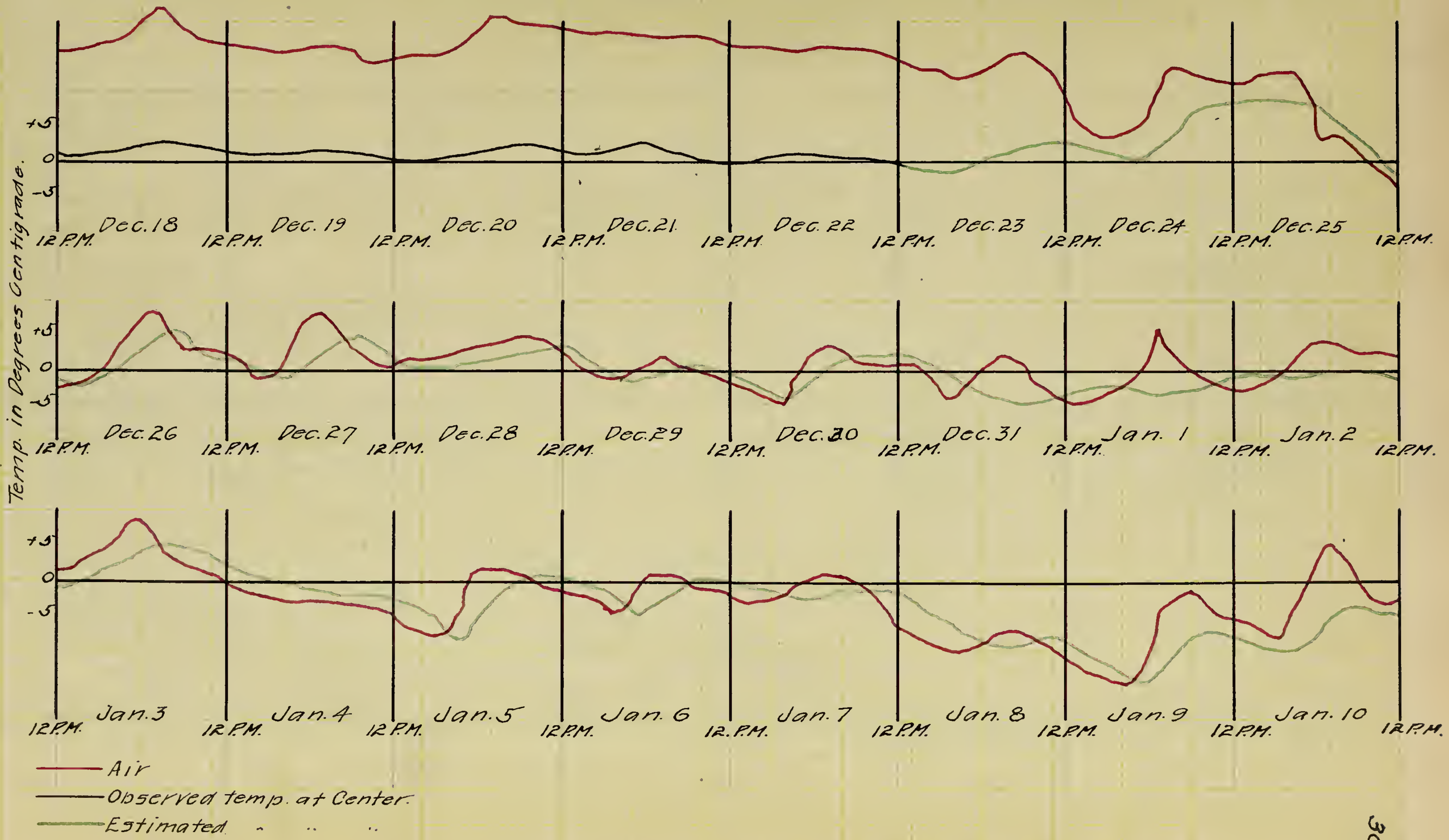
BEAM (Continued)

Date	Air	Distance from End in Inches.						
		7	13	25	37	50	61	73
March 22nd								
8:00 A. M.	-10.2	-8.2	-8.0	-8.0	-8.0	-8.0	-4.3	-4.1
12:00 M.	-6.1	-5.0	-4.6	-4.0	-3.8	-4.0	-4.1	-4.4
5:00 P. M.	-4.8	-4.6	-4.4	-4.2	-3.8	-3.9	-4.1	-4.3
March 23rd								
8:00 A. M.	-5.2	-5.6	-5.0	-4.6	-4.2	-4.4	-4.4	-4.4
12:00 M.	-1.6	-4.2	-4.4	-4.4	-3.9	-4.0	-4.2	-4.4
5:00 P. M.	-1.4	-3.2	-3.8	-4.2	-3.8	-3.8	-4.0	-4.2
March 26th								
8:00 A. M.	+6.2	+1.5	+1.2	+0.9	+0.1	+0.1	+0.4	+0.9
12:00 M.	+9.2	+3.4	+2.8	+0.8	+0.6	+0.6	+0.6	+1.0
5:00 P. M.	+4.6	+2.6	+2.0	+1.2	+1.0	+0.9	+0.7	+1.0
March 27th								
8:00 A. M.	+3.1	+4.4	+4.6	+3.9	+3.4	+3.3	+3.4	+3.2
12:00 M.	+4.4	+4.2	+4.4	+4.4	+4.4	+3.4	+3.4	+2.6
5:00 P. M.	+3.4	+4.2	+4.2	+3.8	+3.6	+3.4	+3.6	+3.5
March 28th								
8:00 A. M.	+0.8	+2.6	+3.1	+3.1	+3.2	+3.0	+3.0	+2.8
12:00 M.	+2.0	+2.4	+2.9	+2.8	+3.0	+2.8	+2.8	+2.6
5:00 P. M.	+1.0	+1.8	+2.5	+2.6	+2.8	+2.6	+2.6	+2.5

DATA FOR CONCRETE CULVERT.

Date.	Hour.	Air	Temp. of Concrete.
Feb 7th	4:00 P.M.	-3.5	-6.5
Feb 10th	4:00 P.M.	-4.4	-6.0
Mar 1st	4:00 P.M.	+6.5	-1.0
Mar 20th	4:00 P.M.	+5.0	-0.9
Mar 30th	4:00 P.M.	+5.6	-0.9

TEMPERATURE IN CYLINDER No 1



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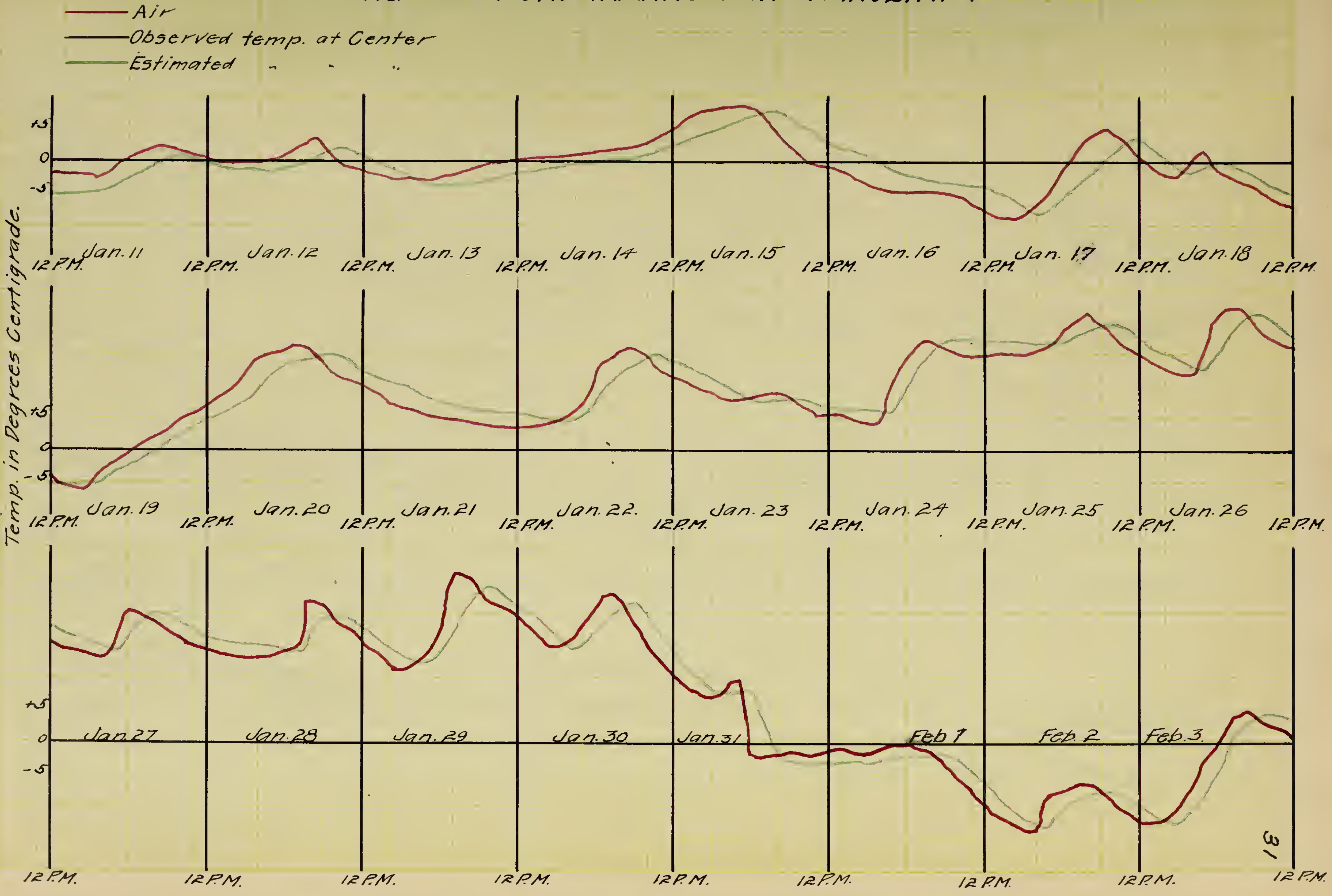

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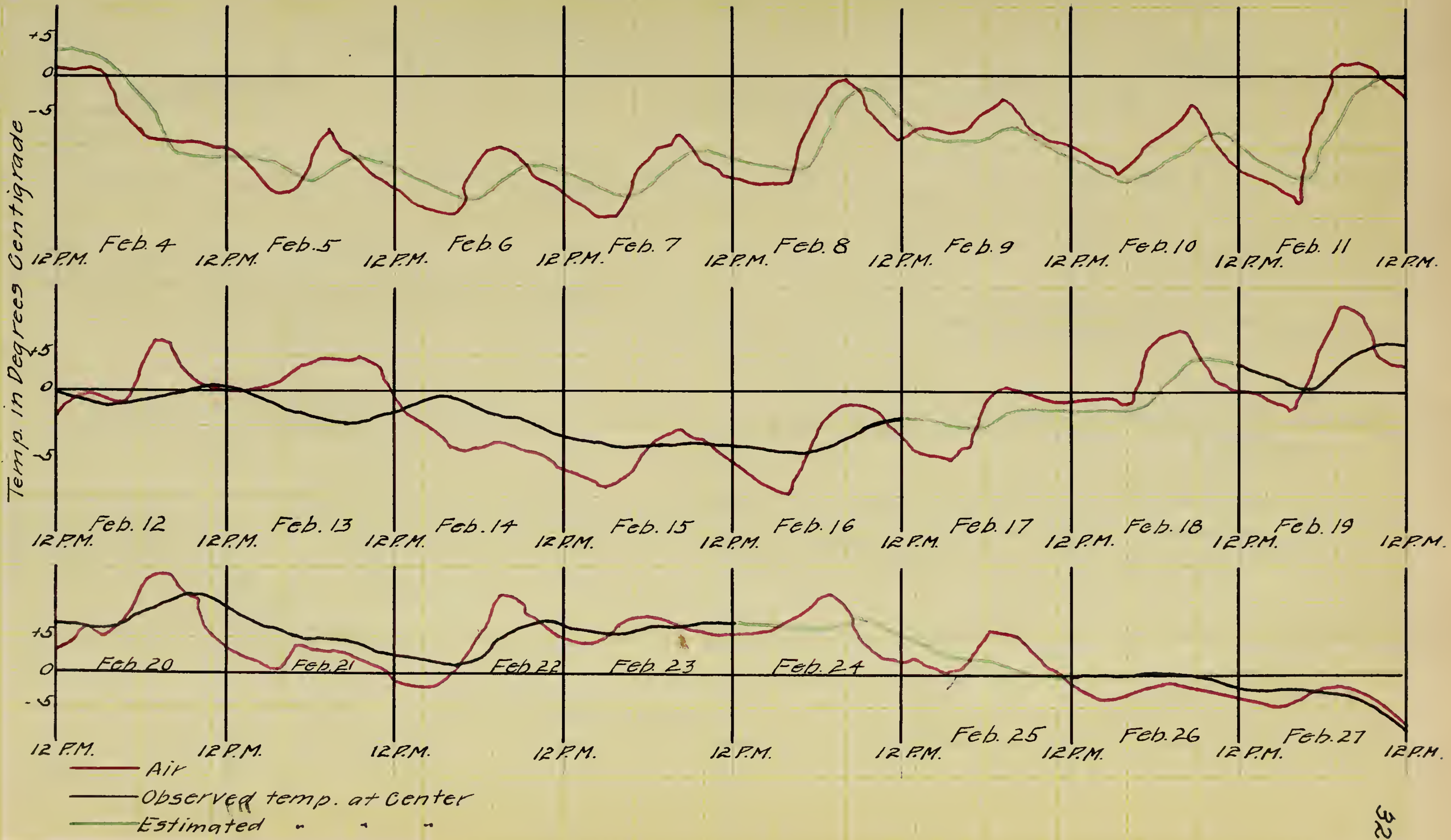

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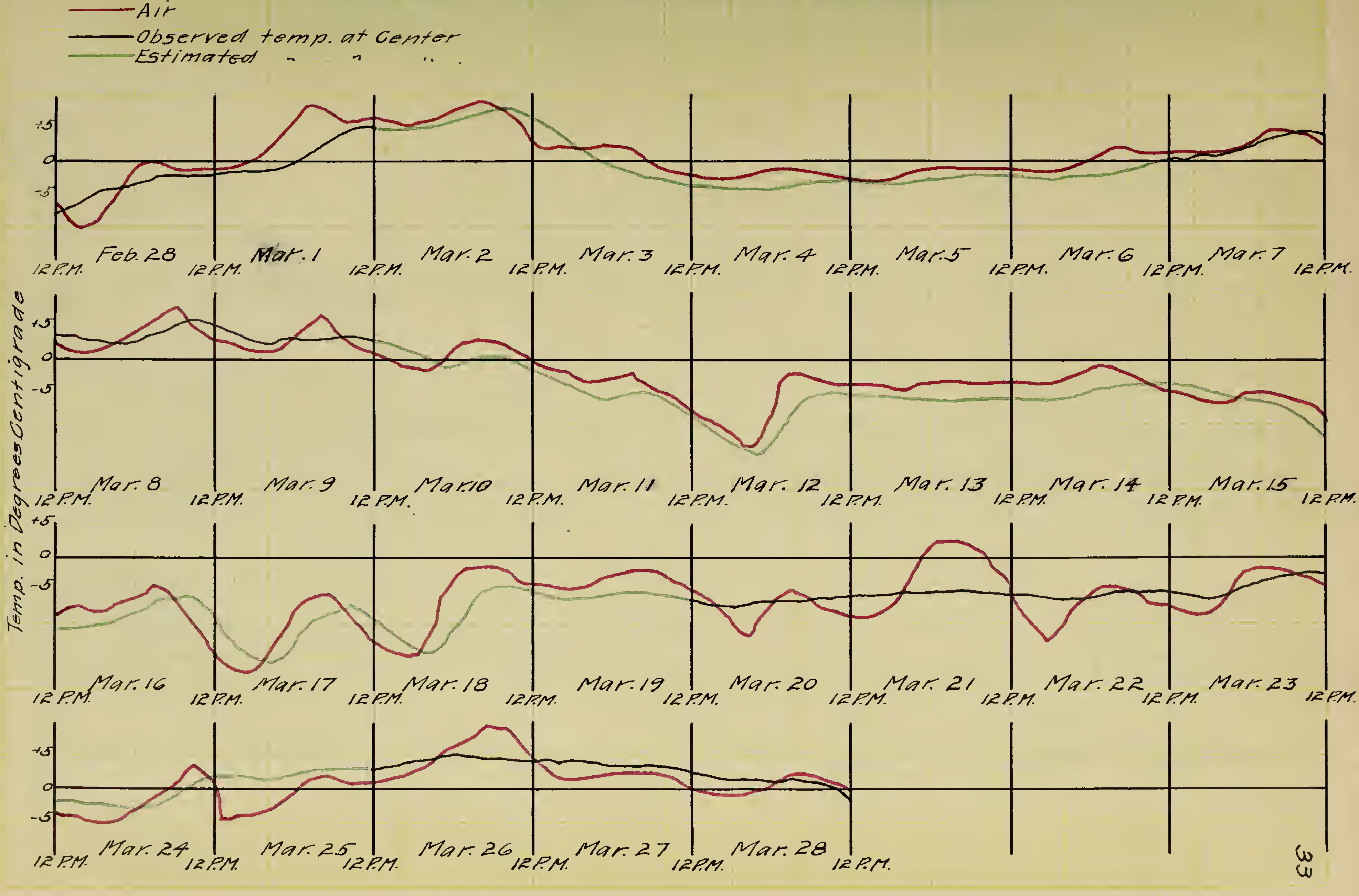

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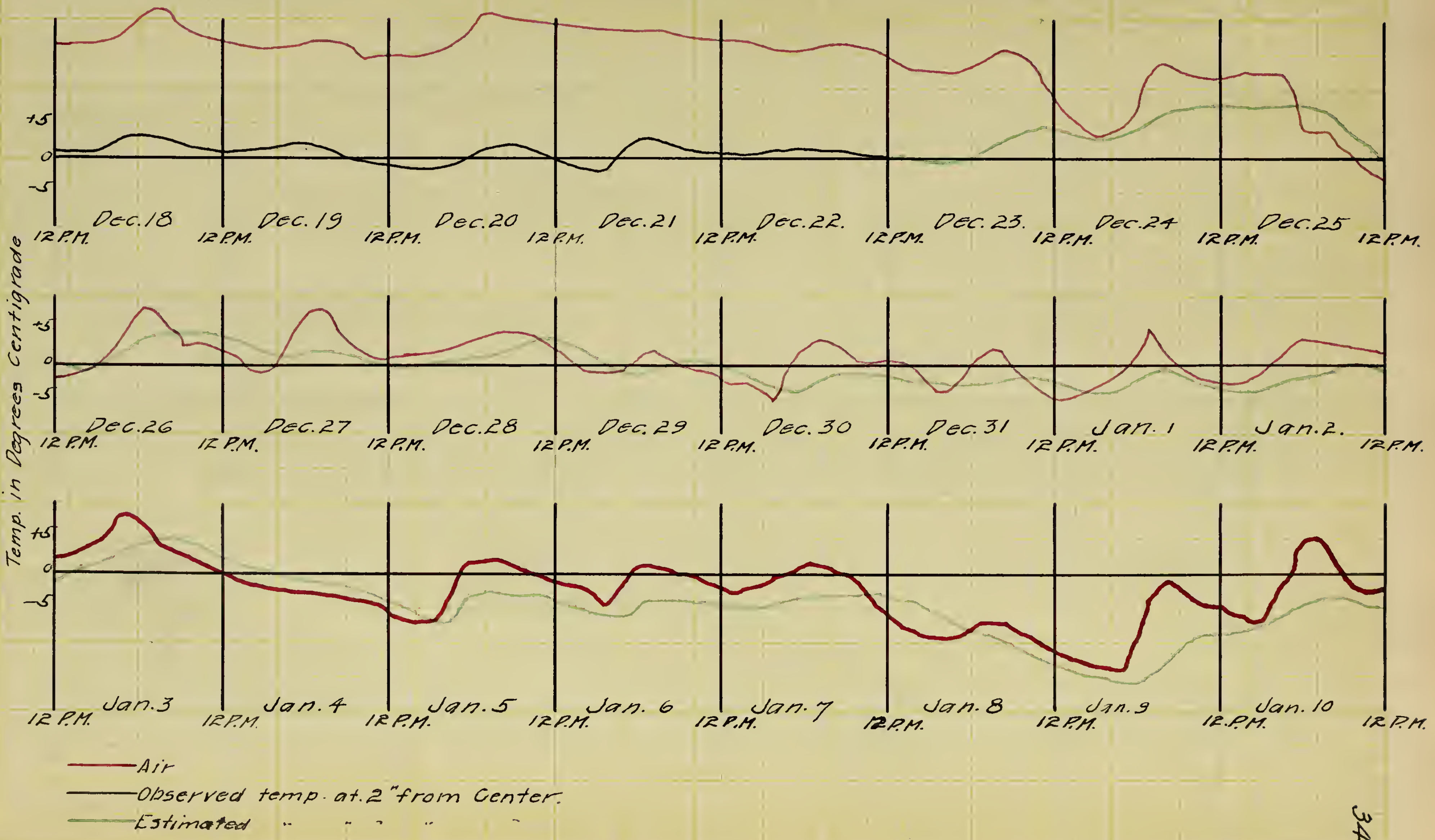

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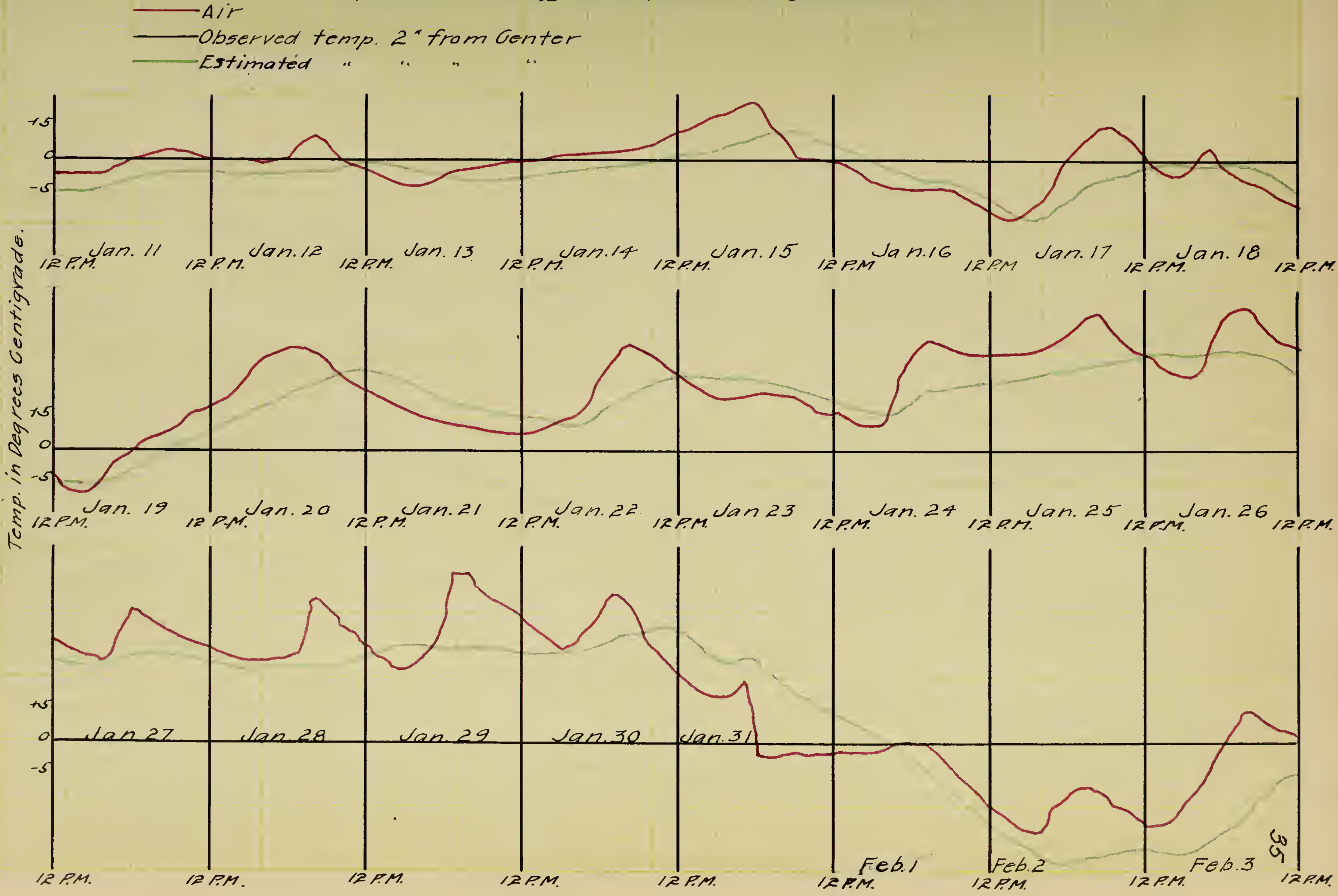

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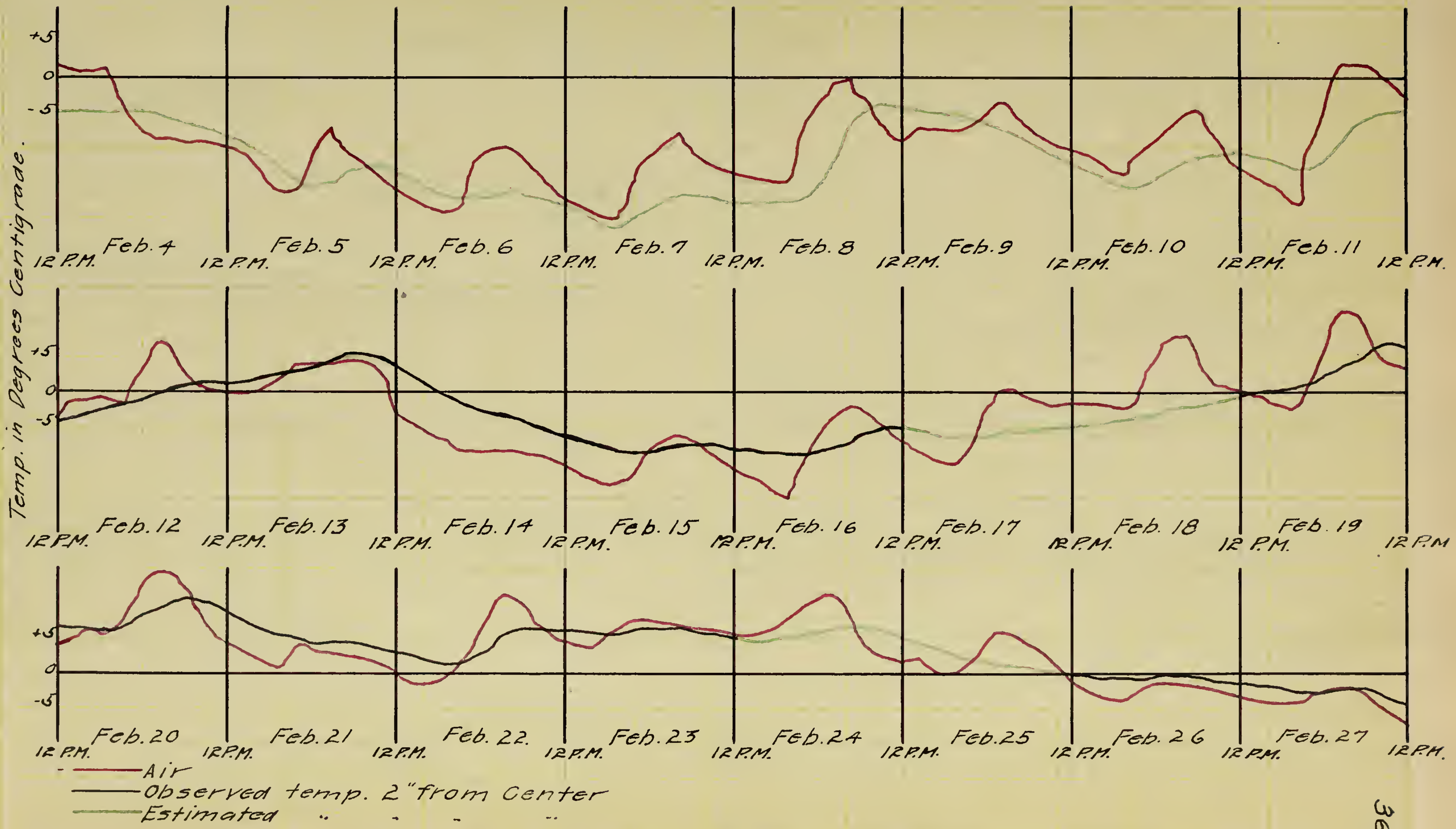

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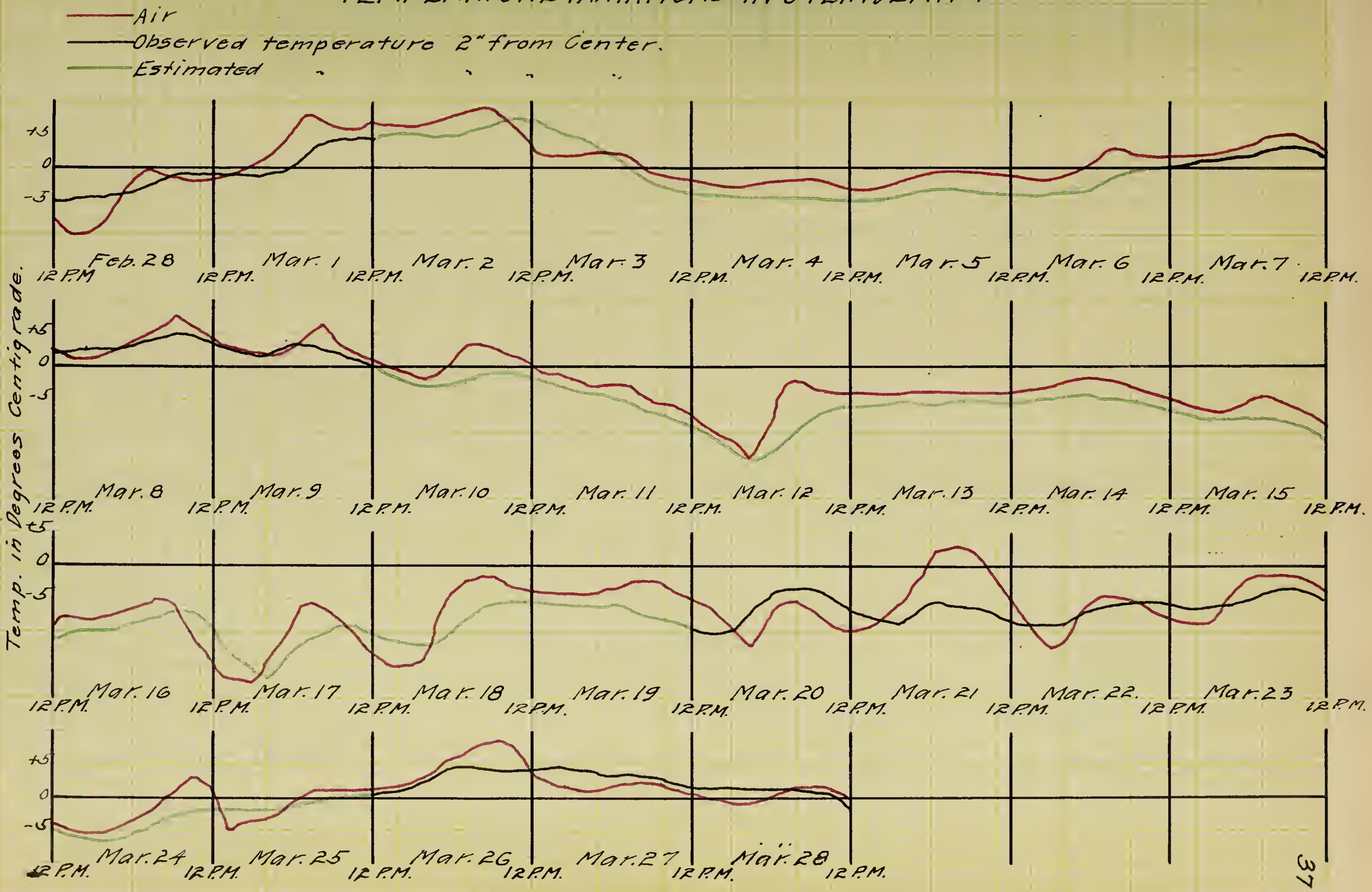

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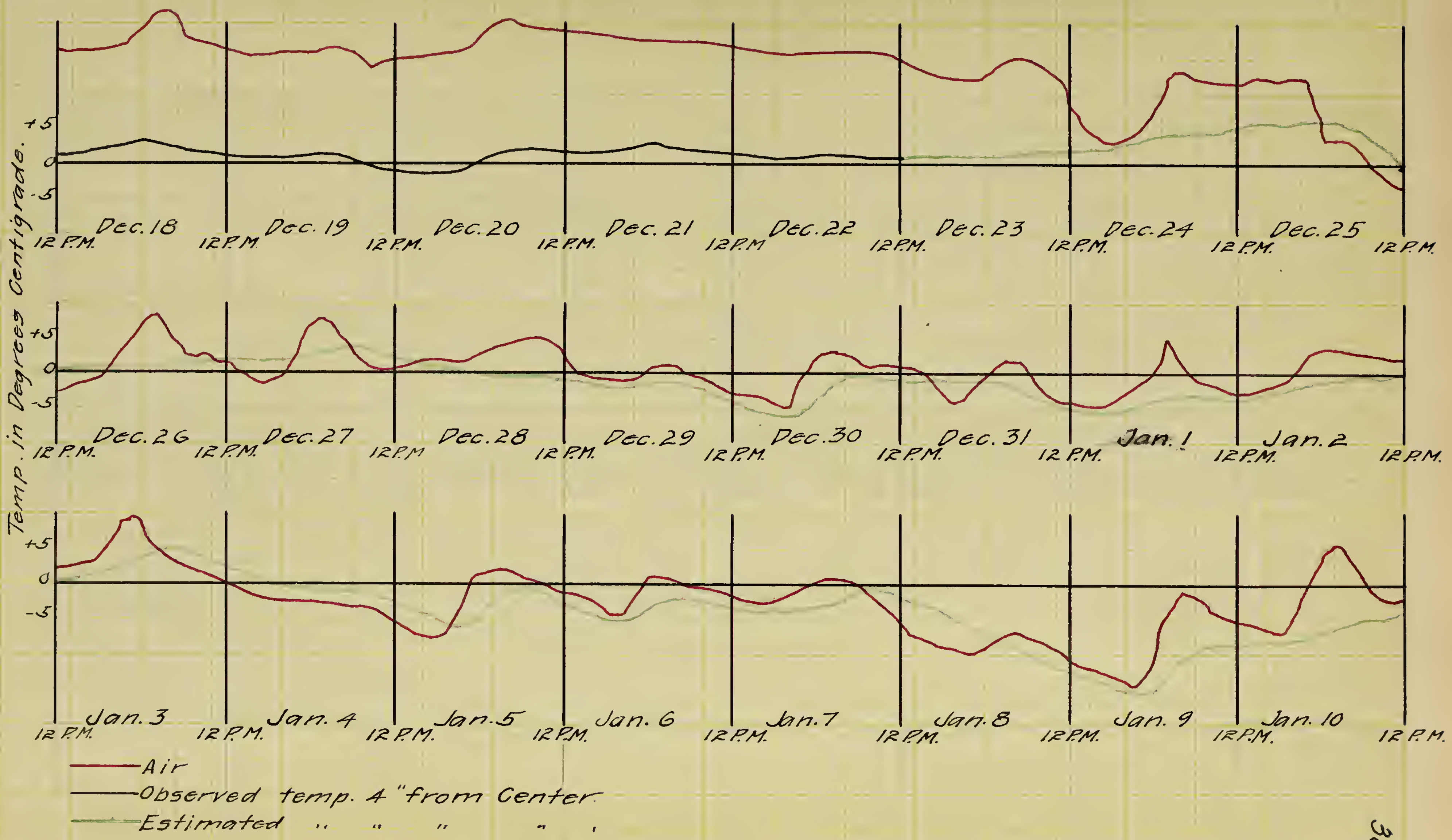

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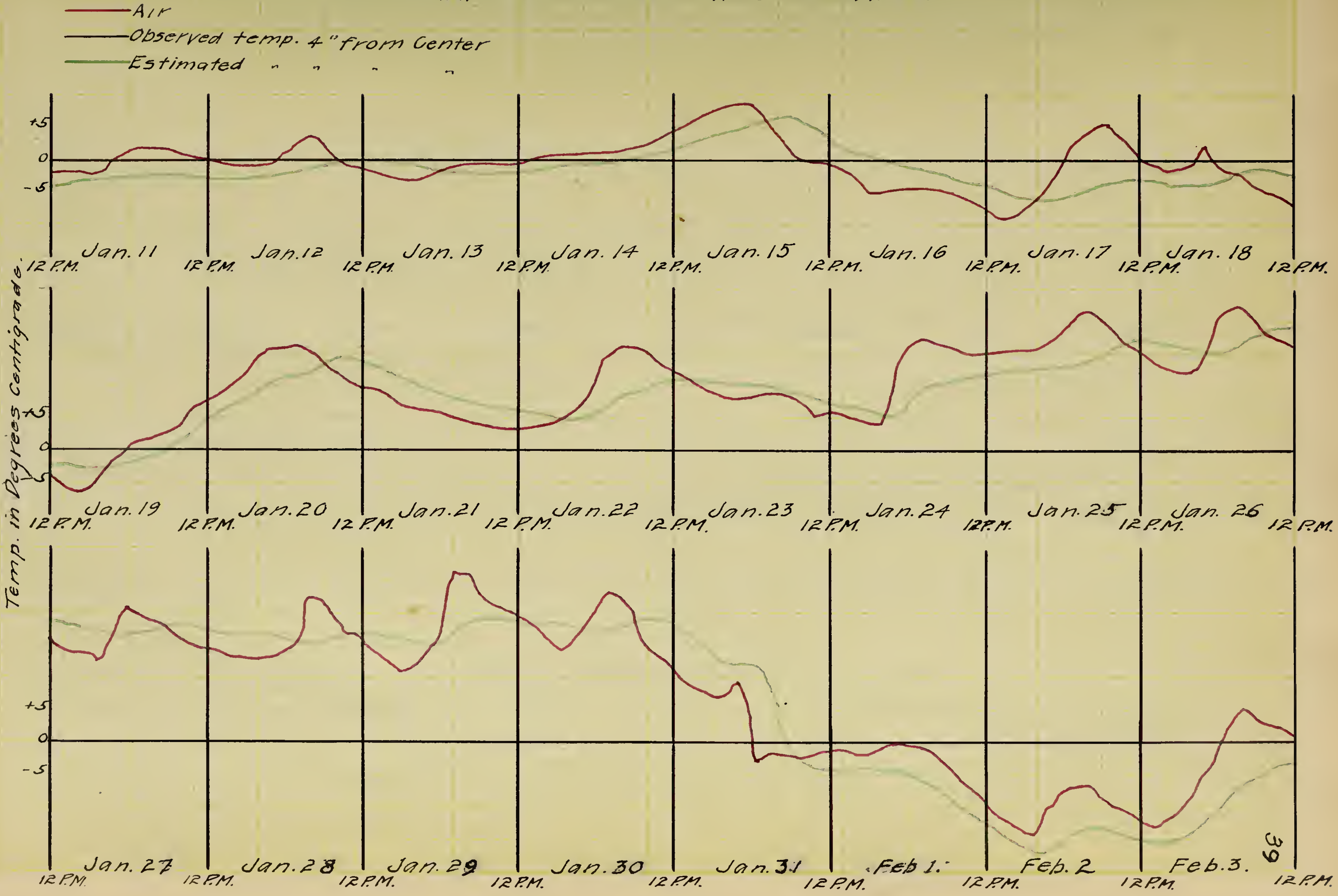

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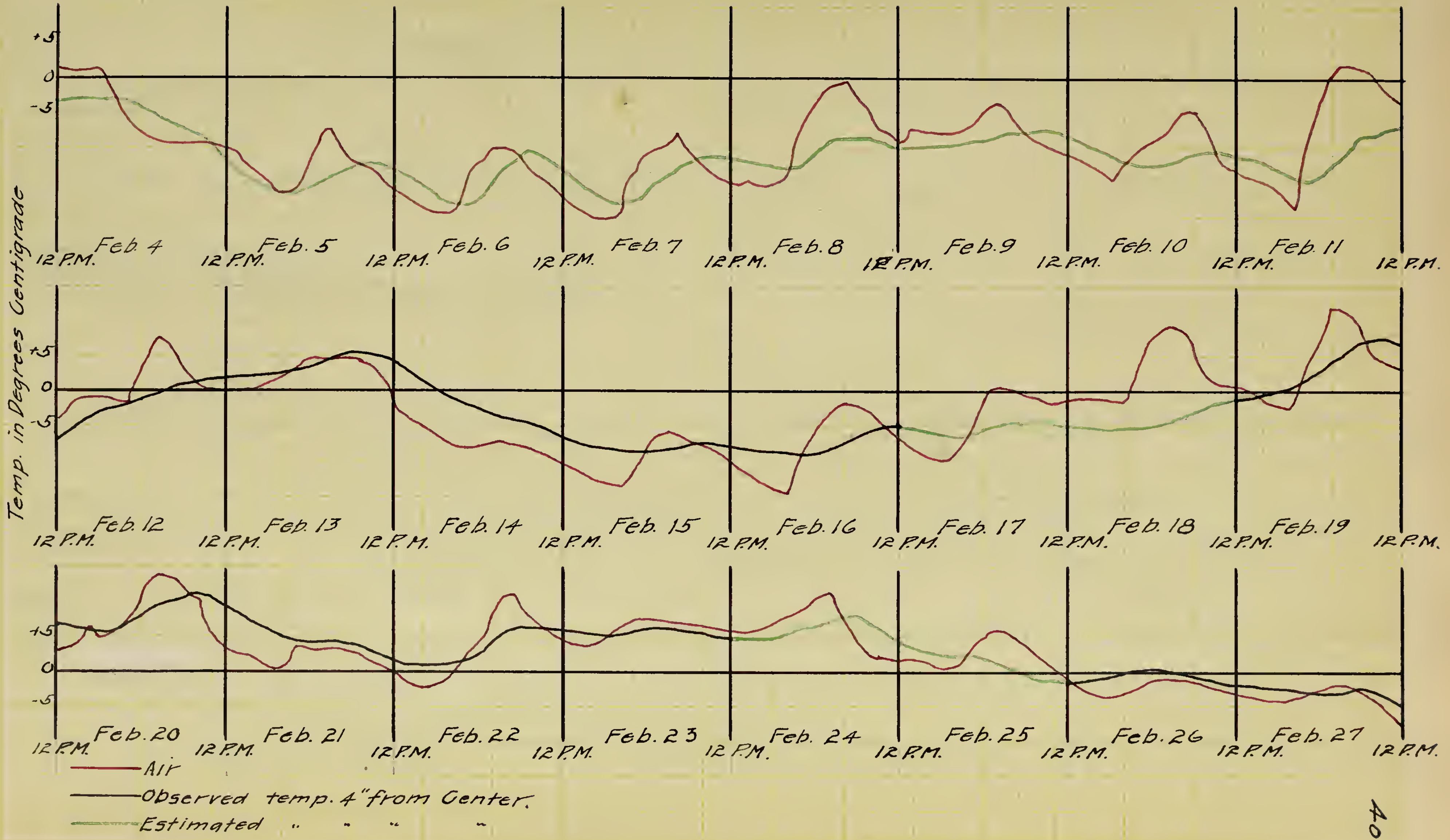

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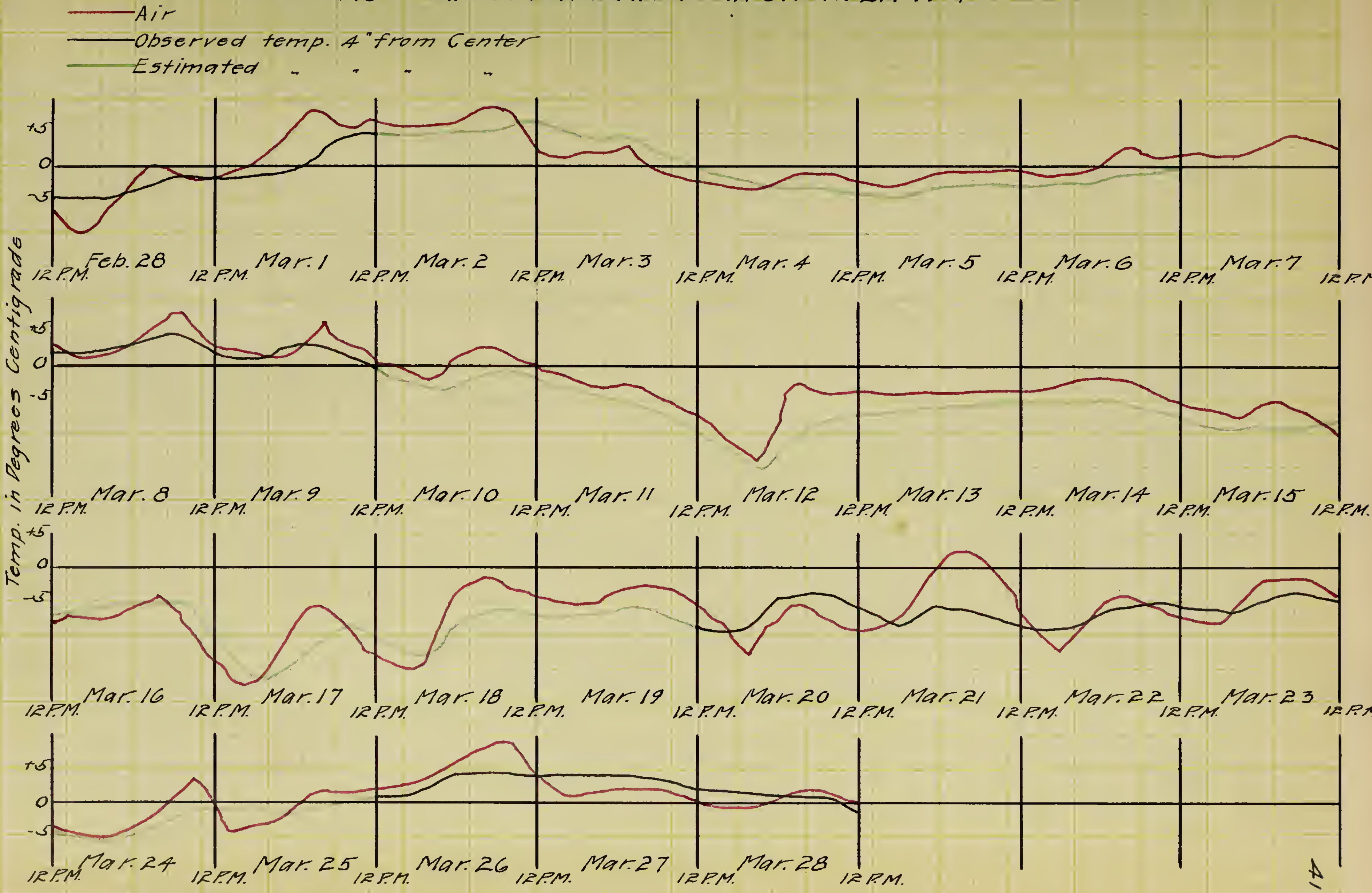

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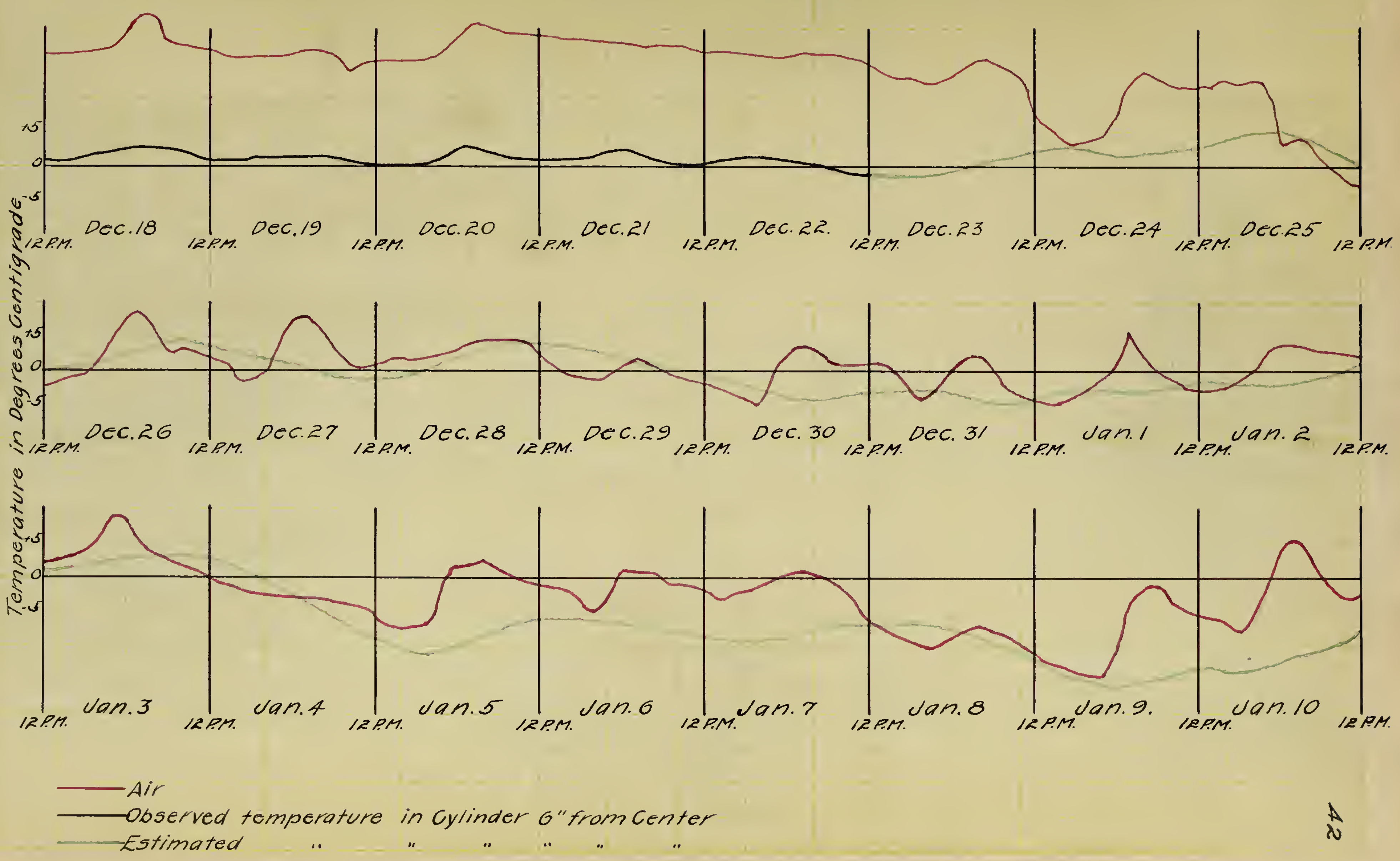

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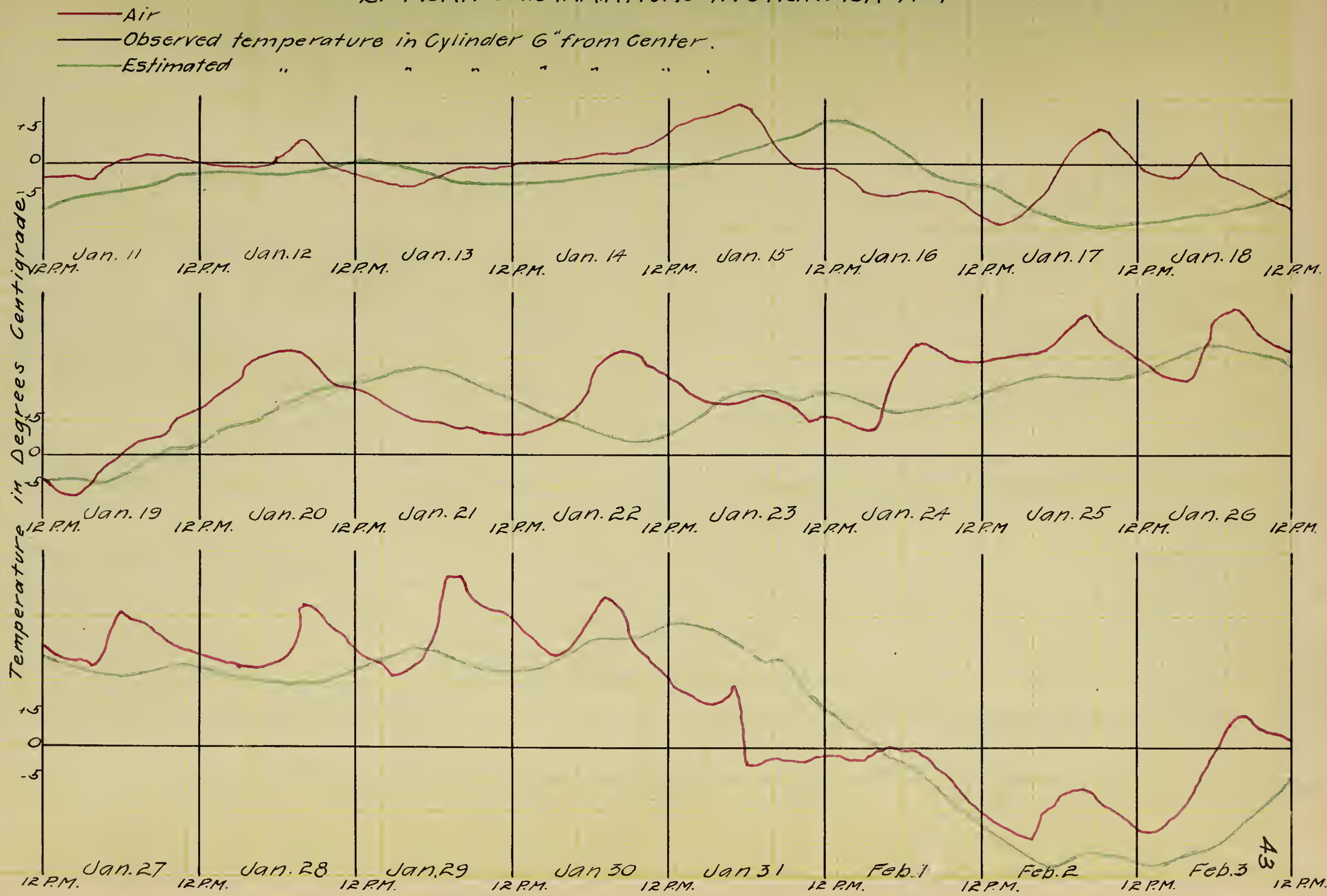

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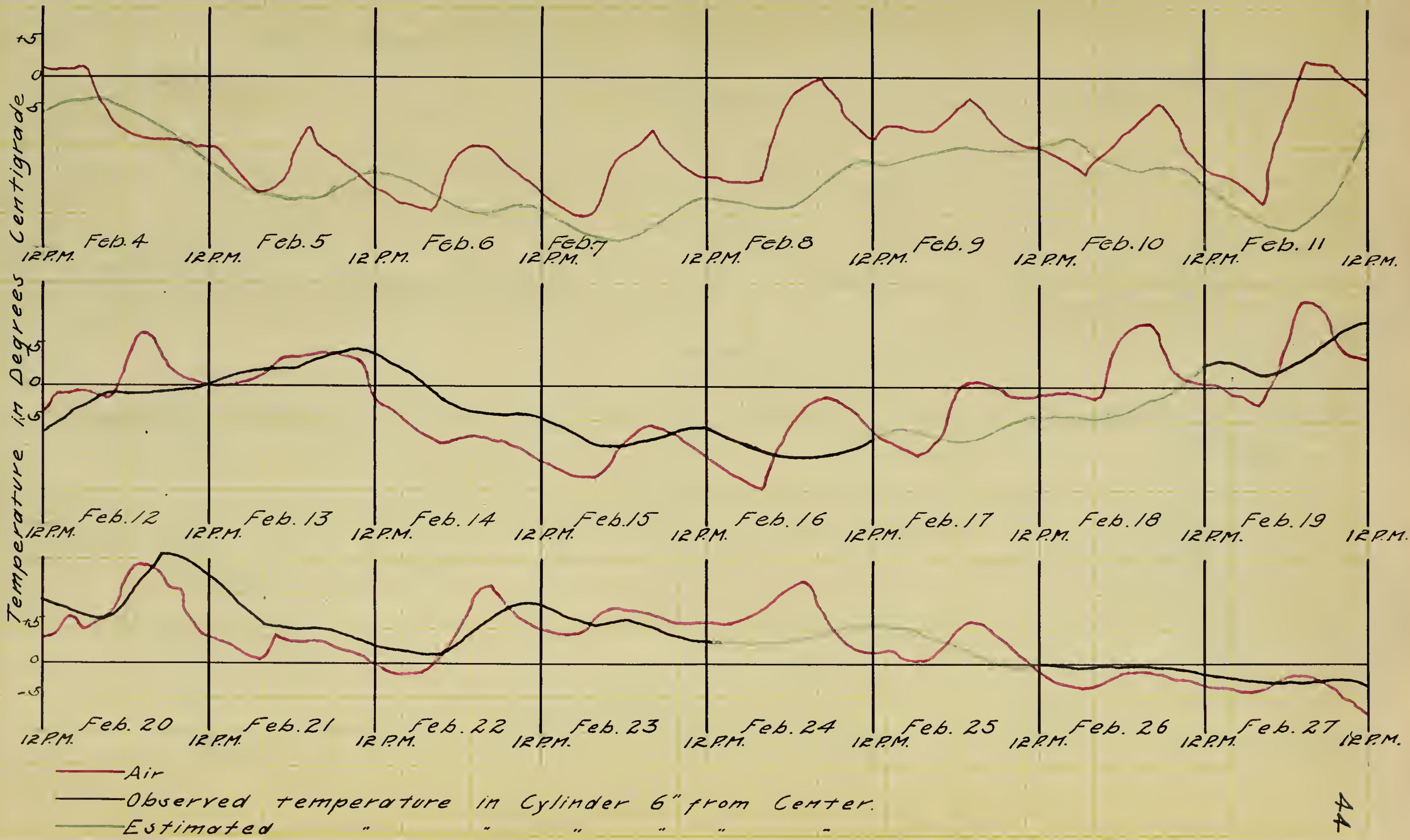

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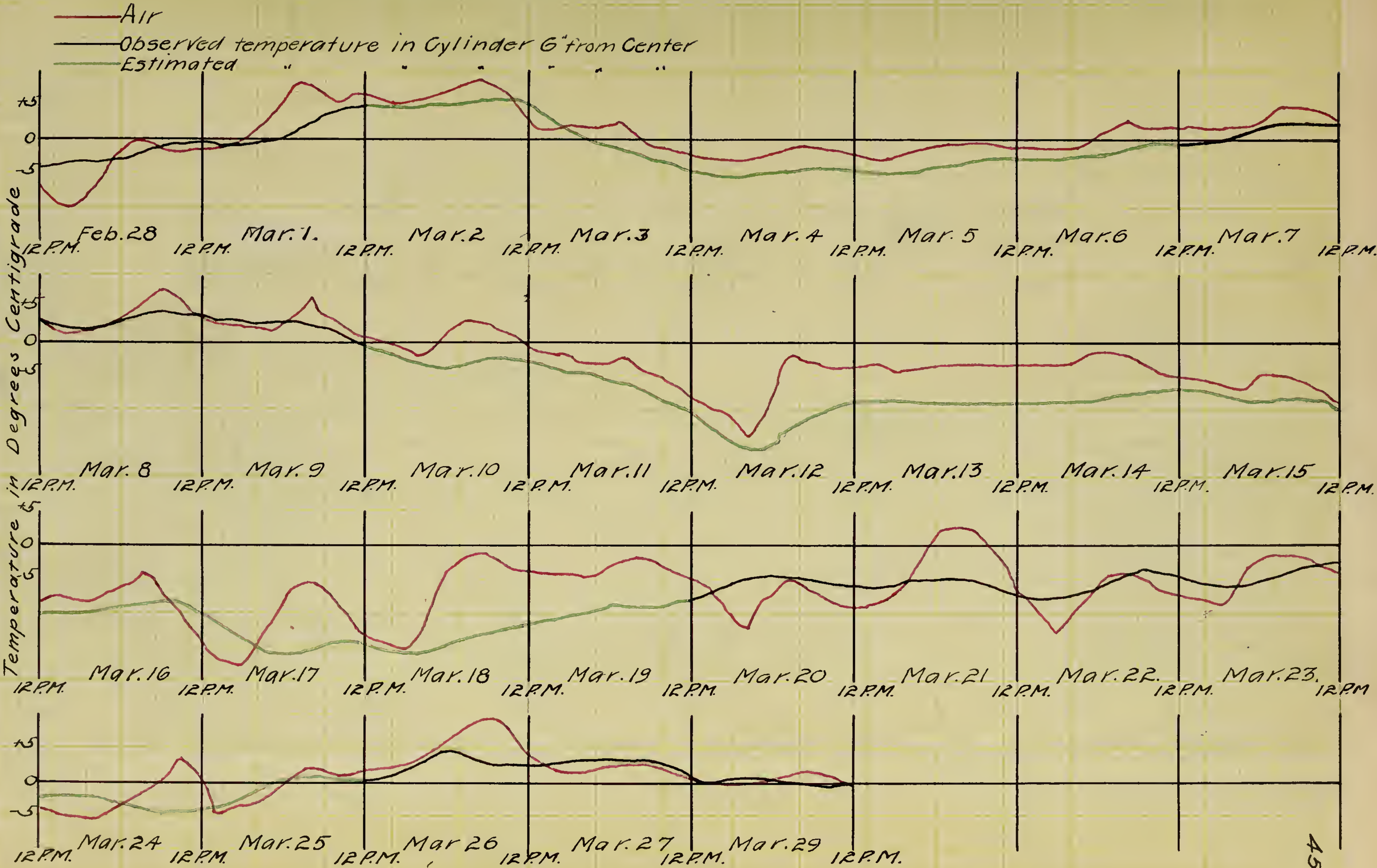

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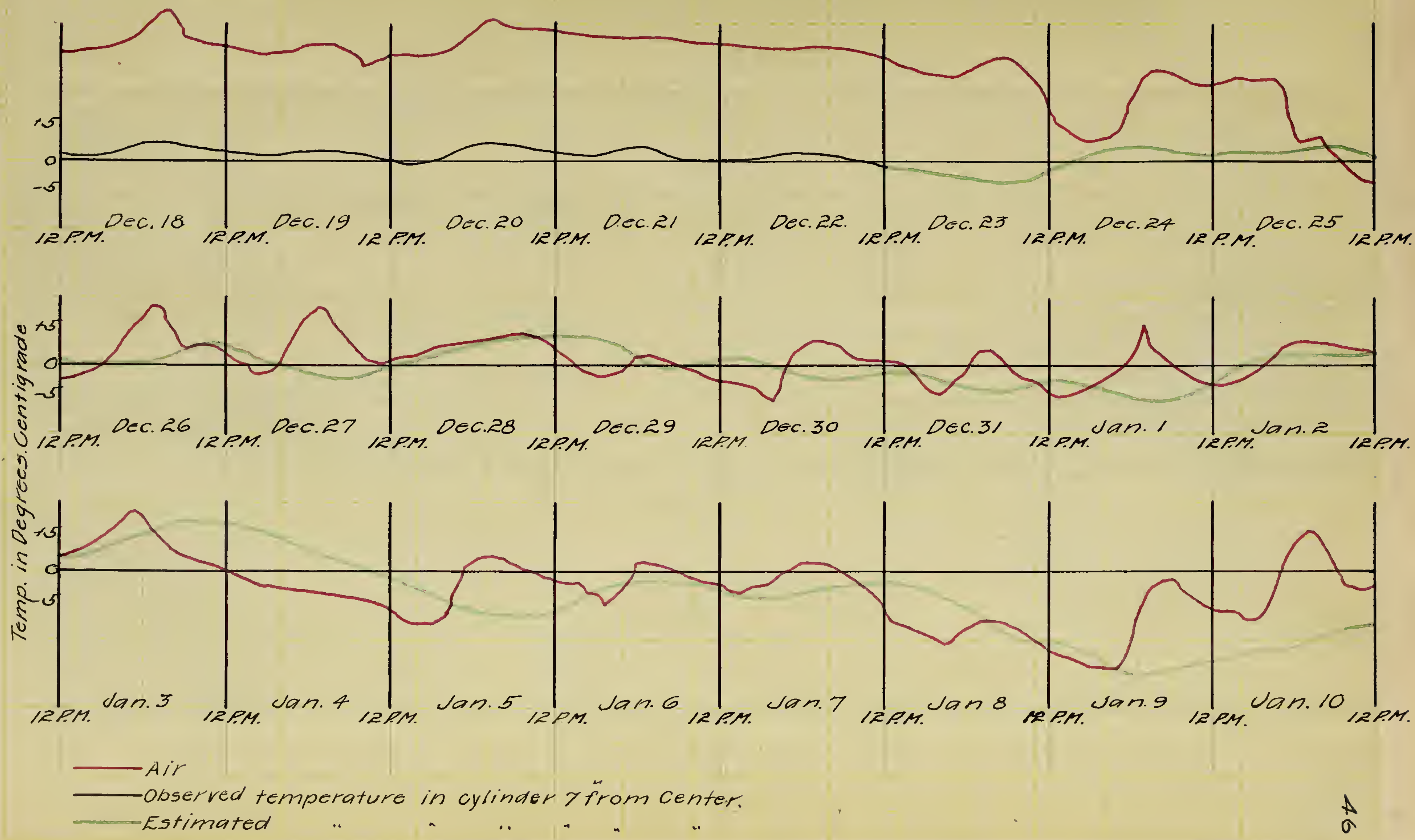

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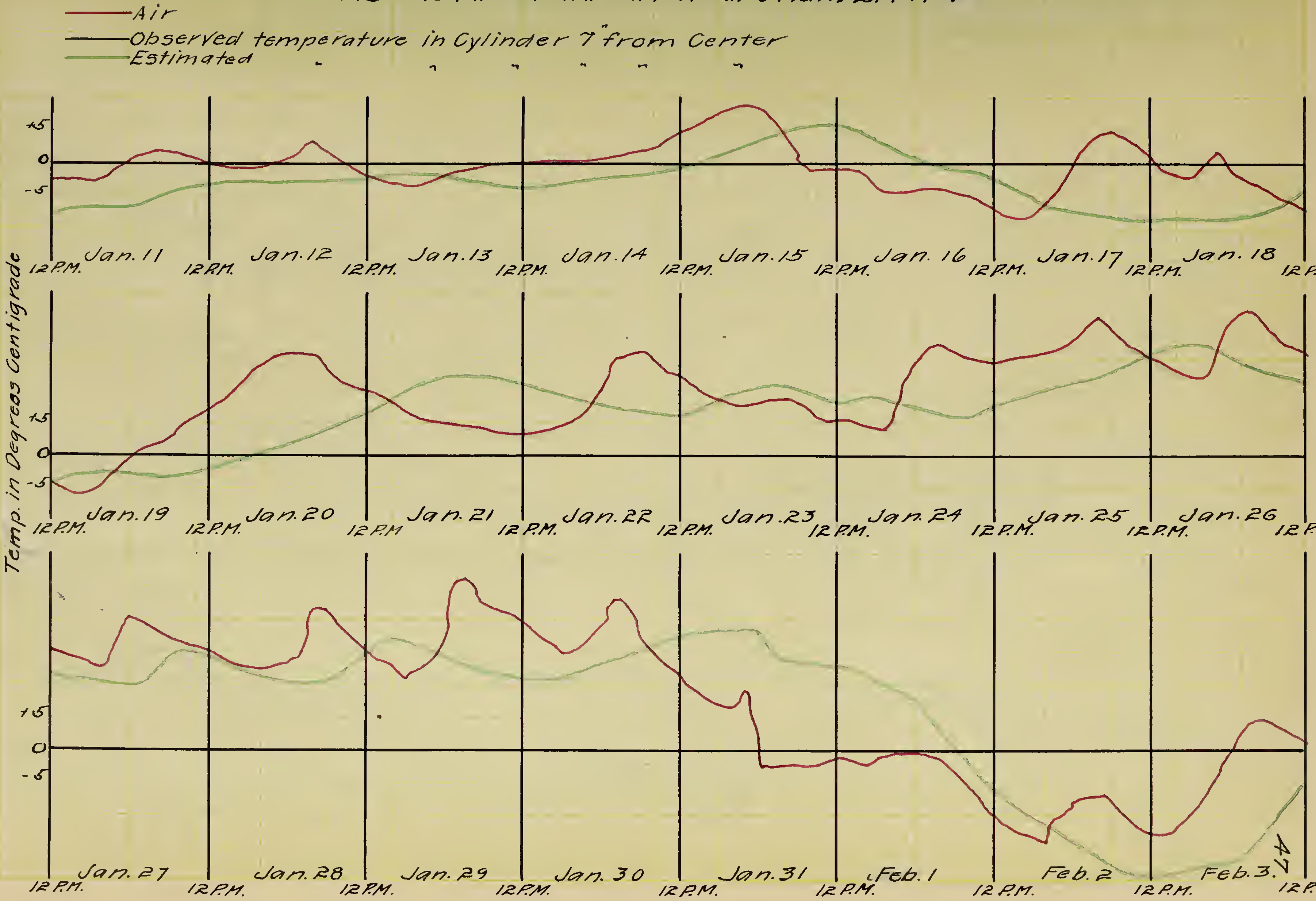

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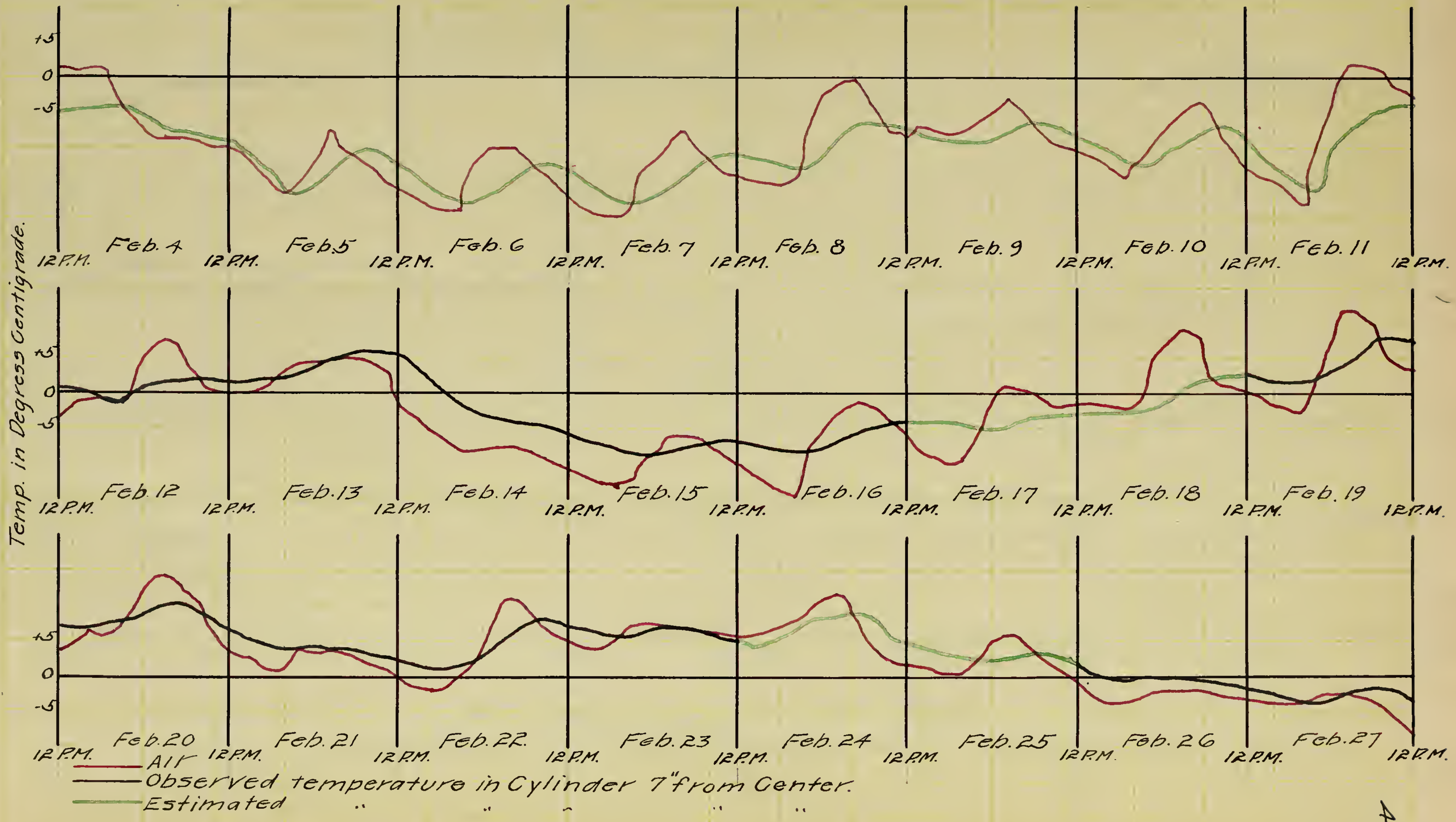

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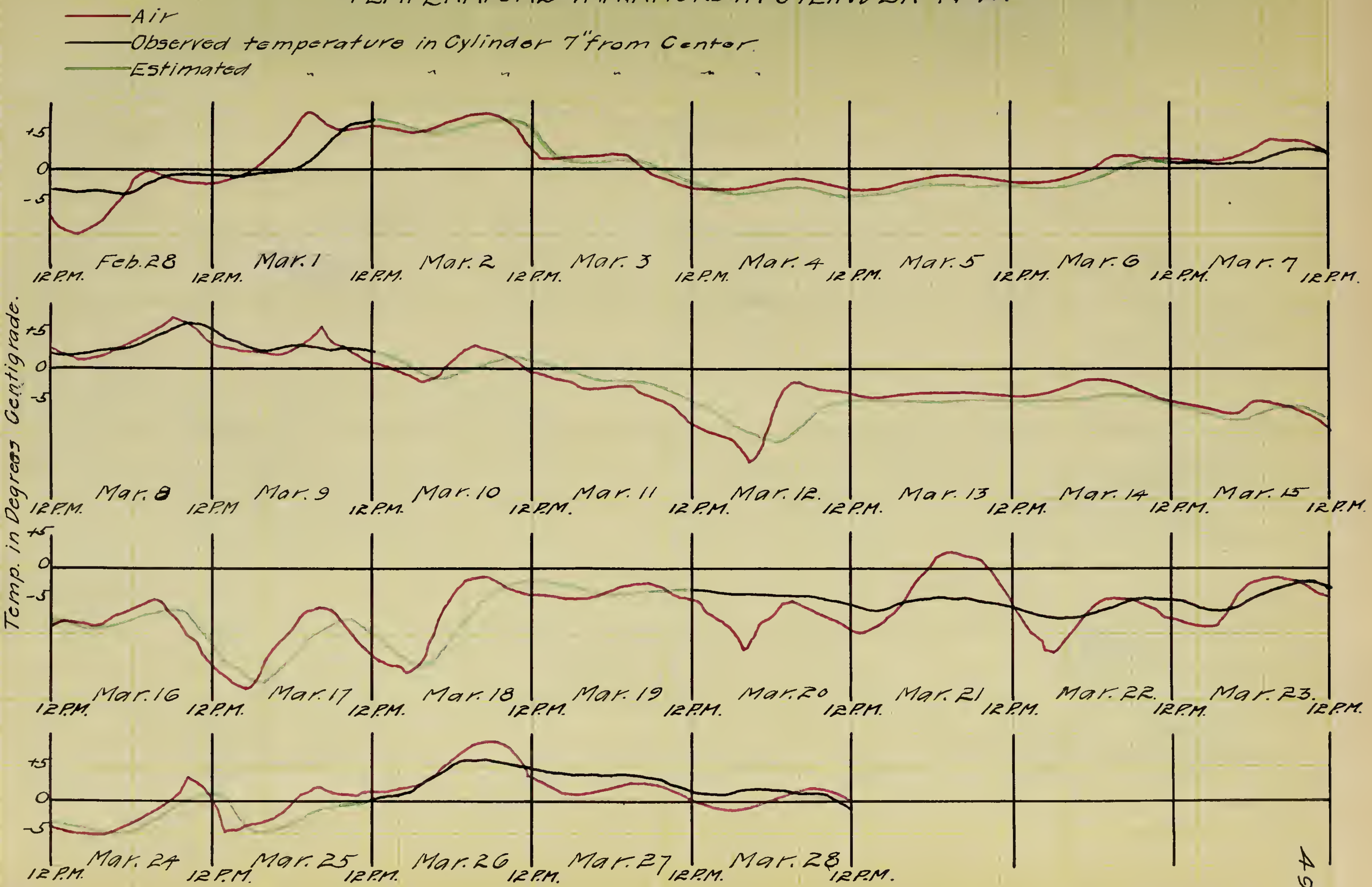

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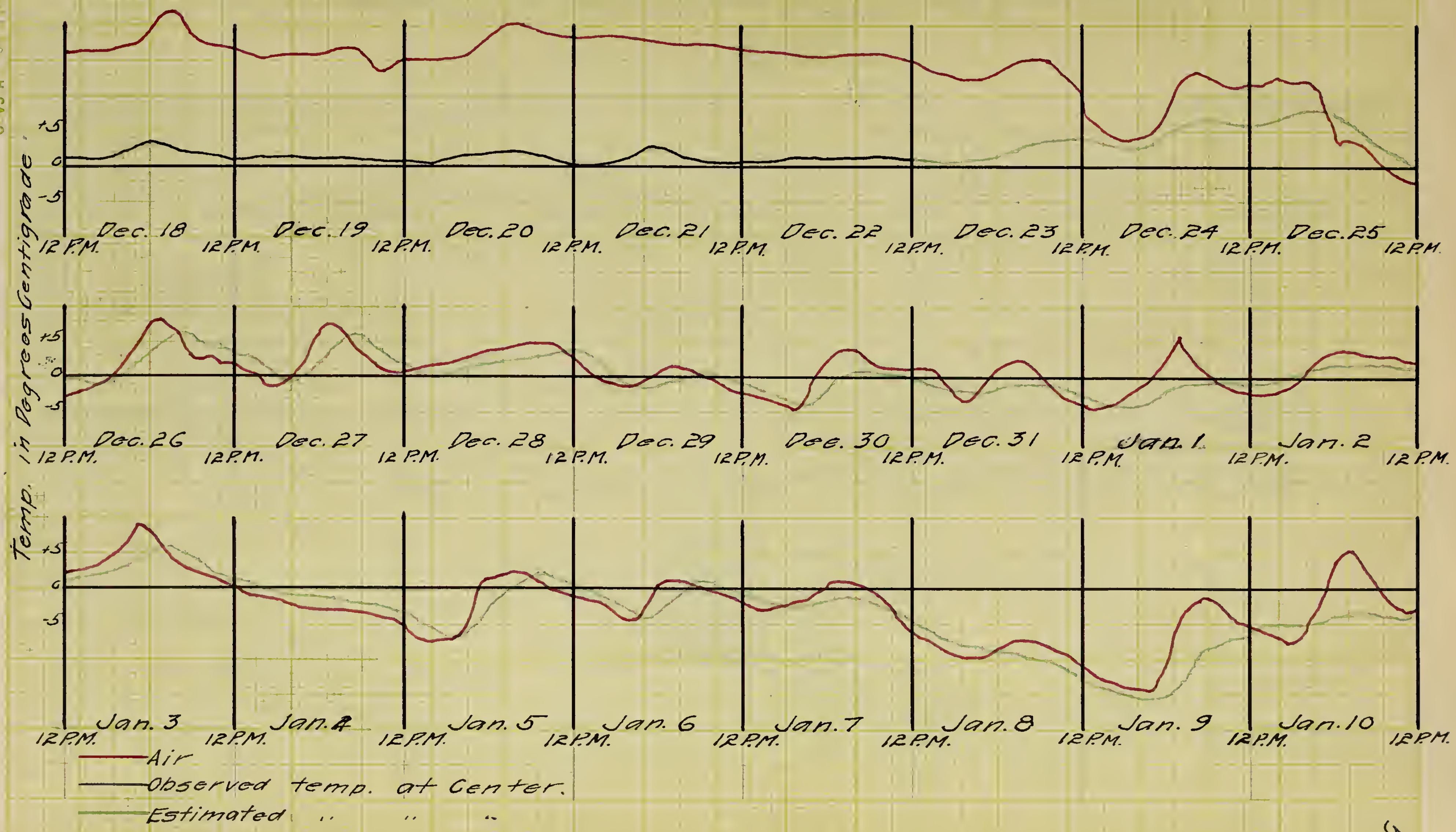

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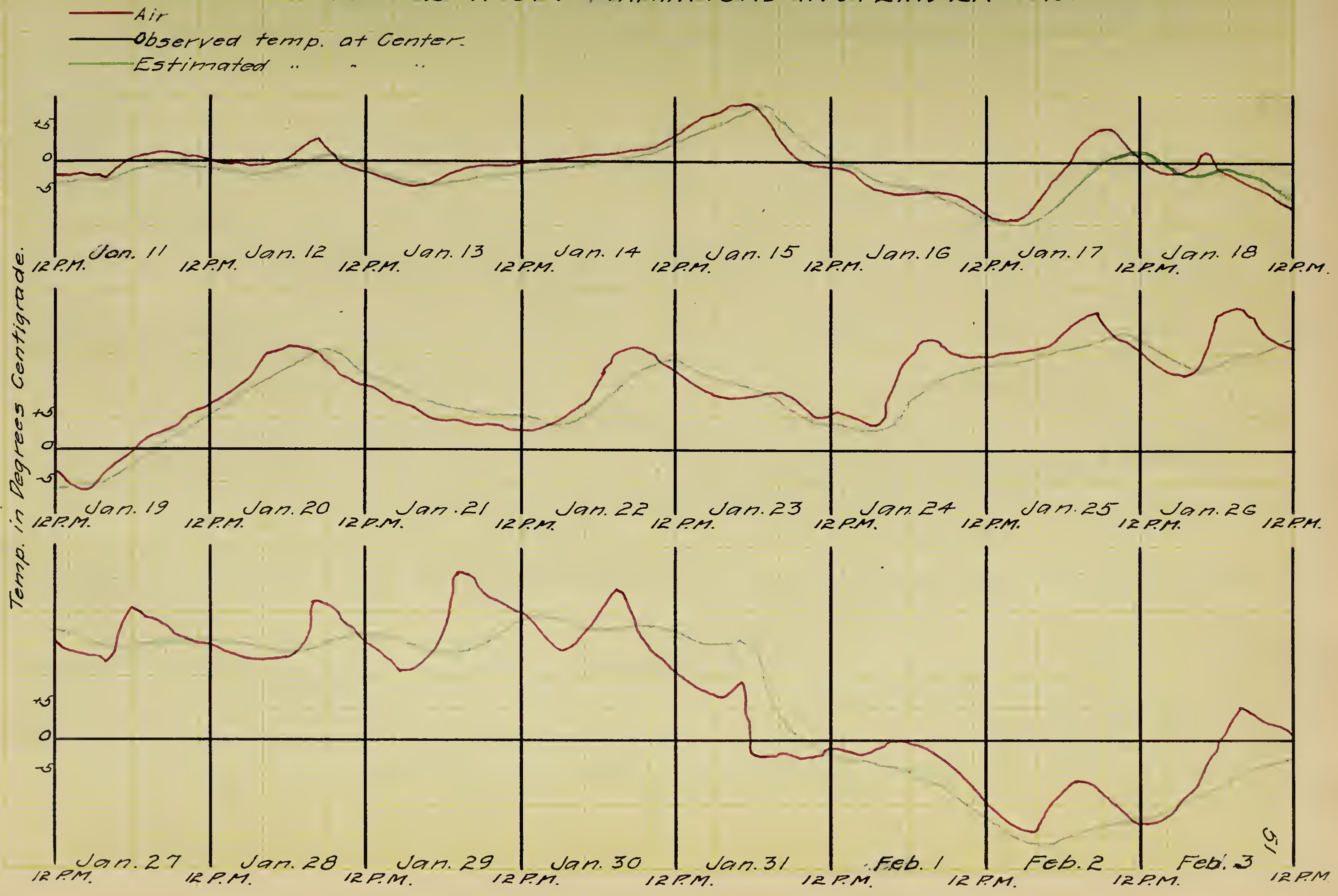

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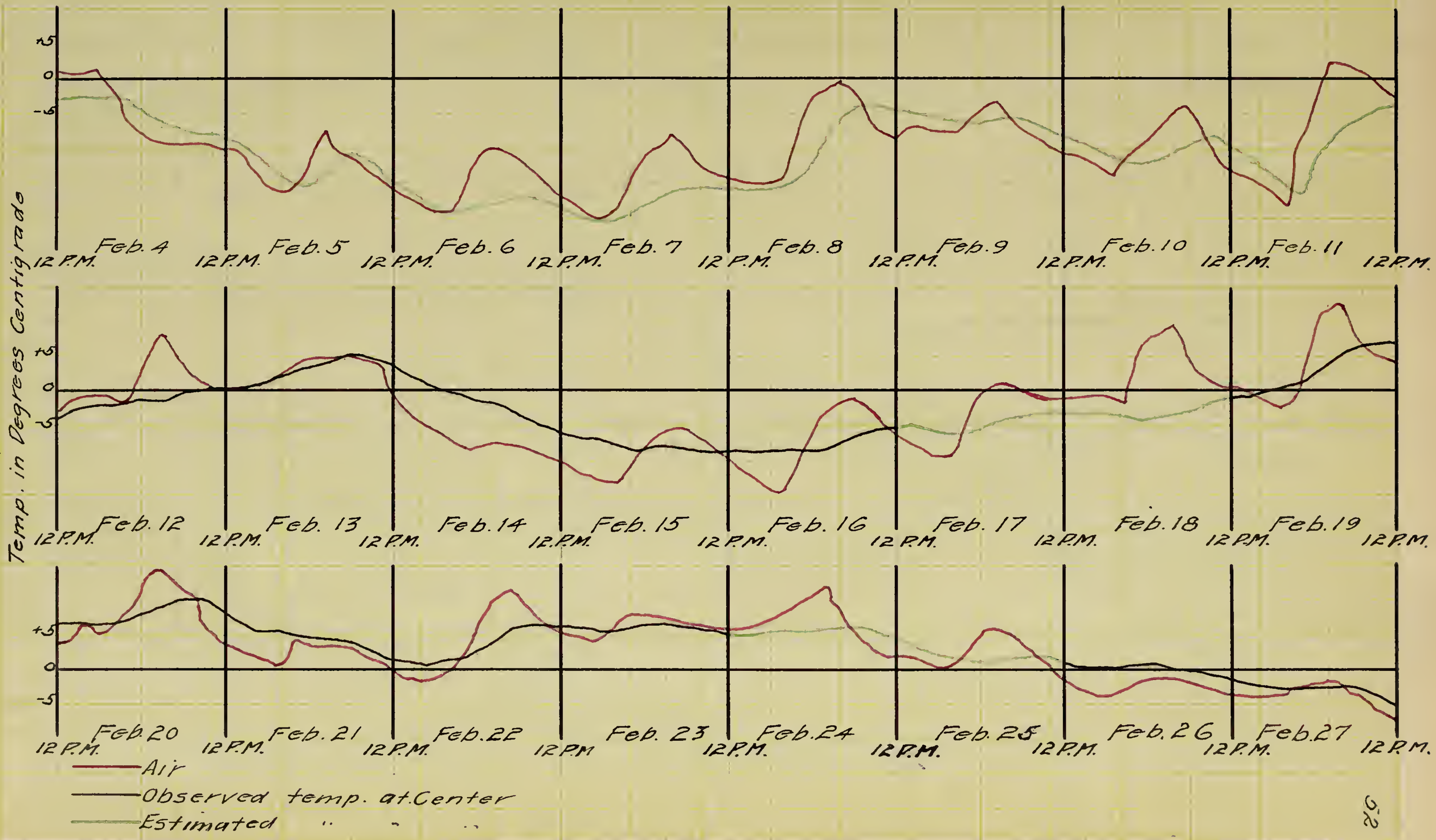

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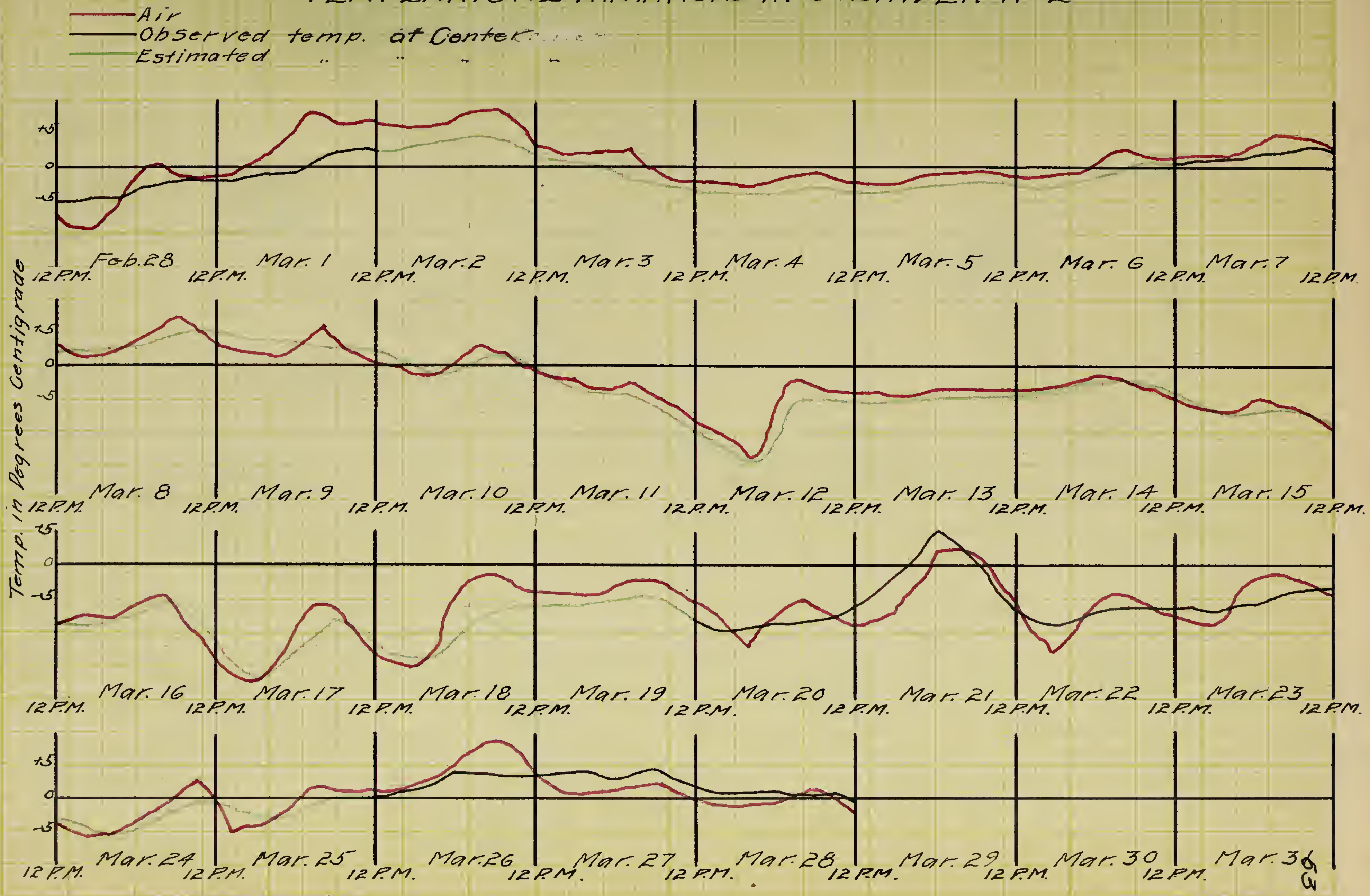

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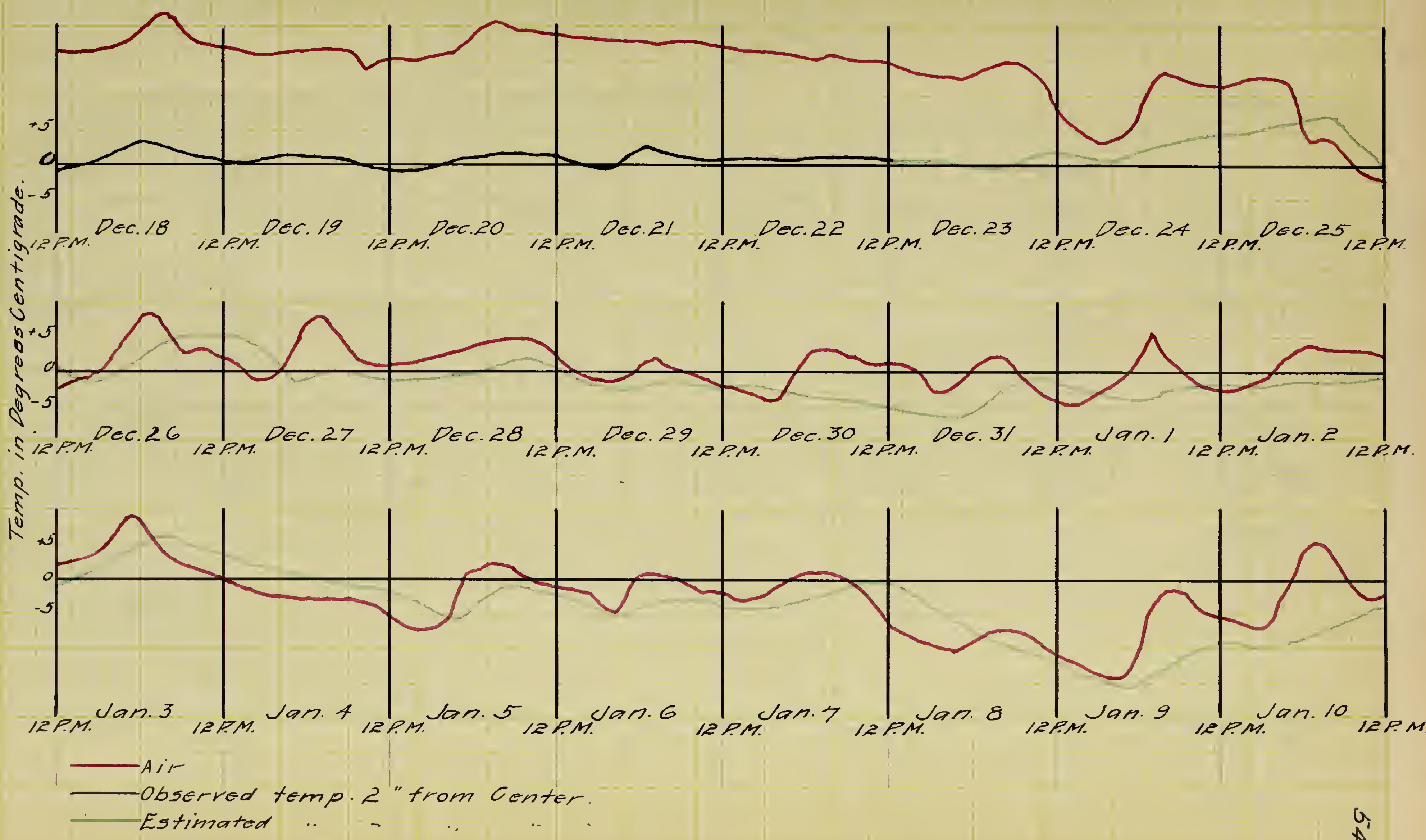

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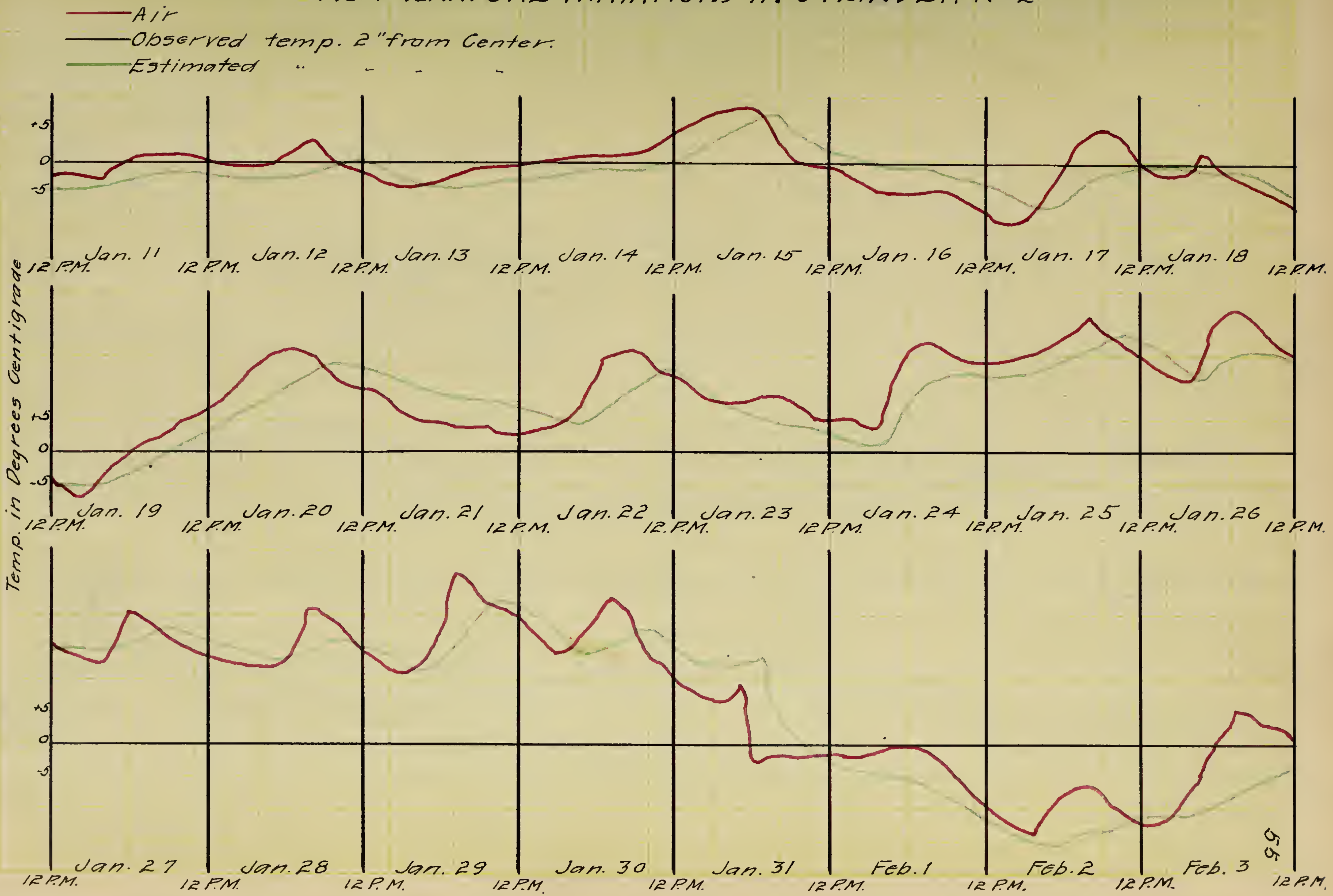

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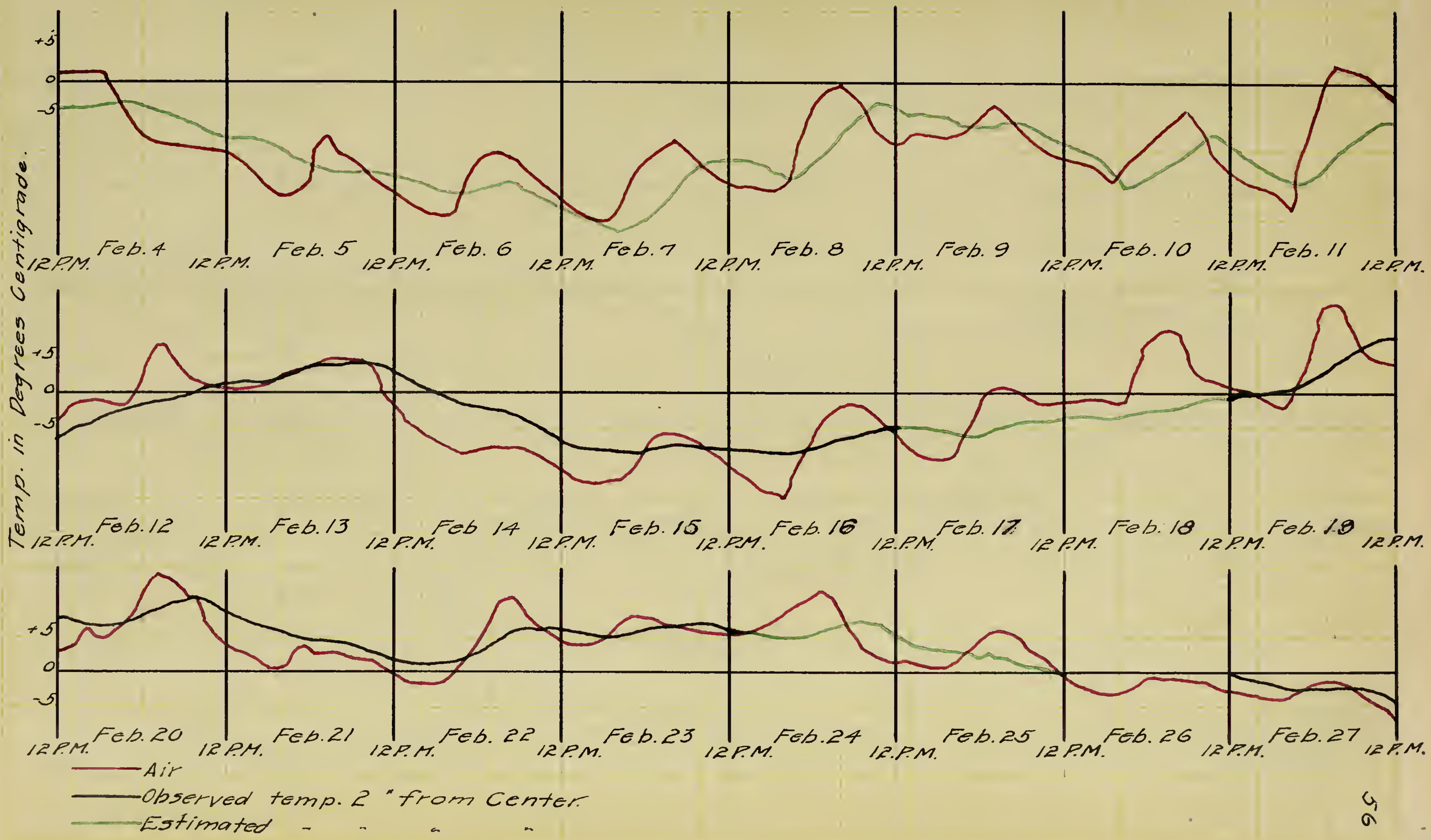

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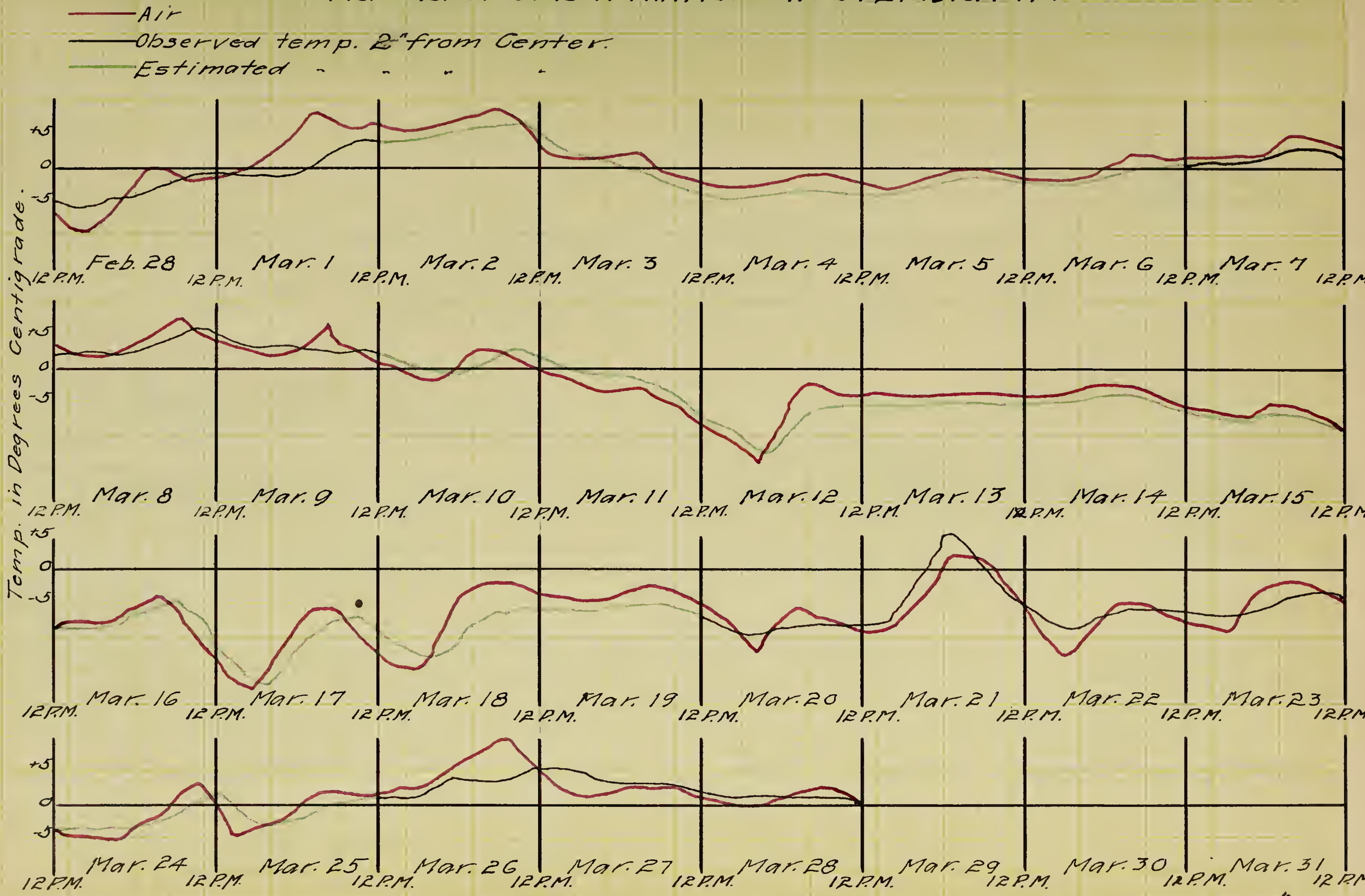

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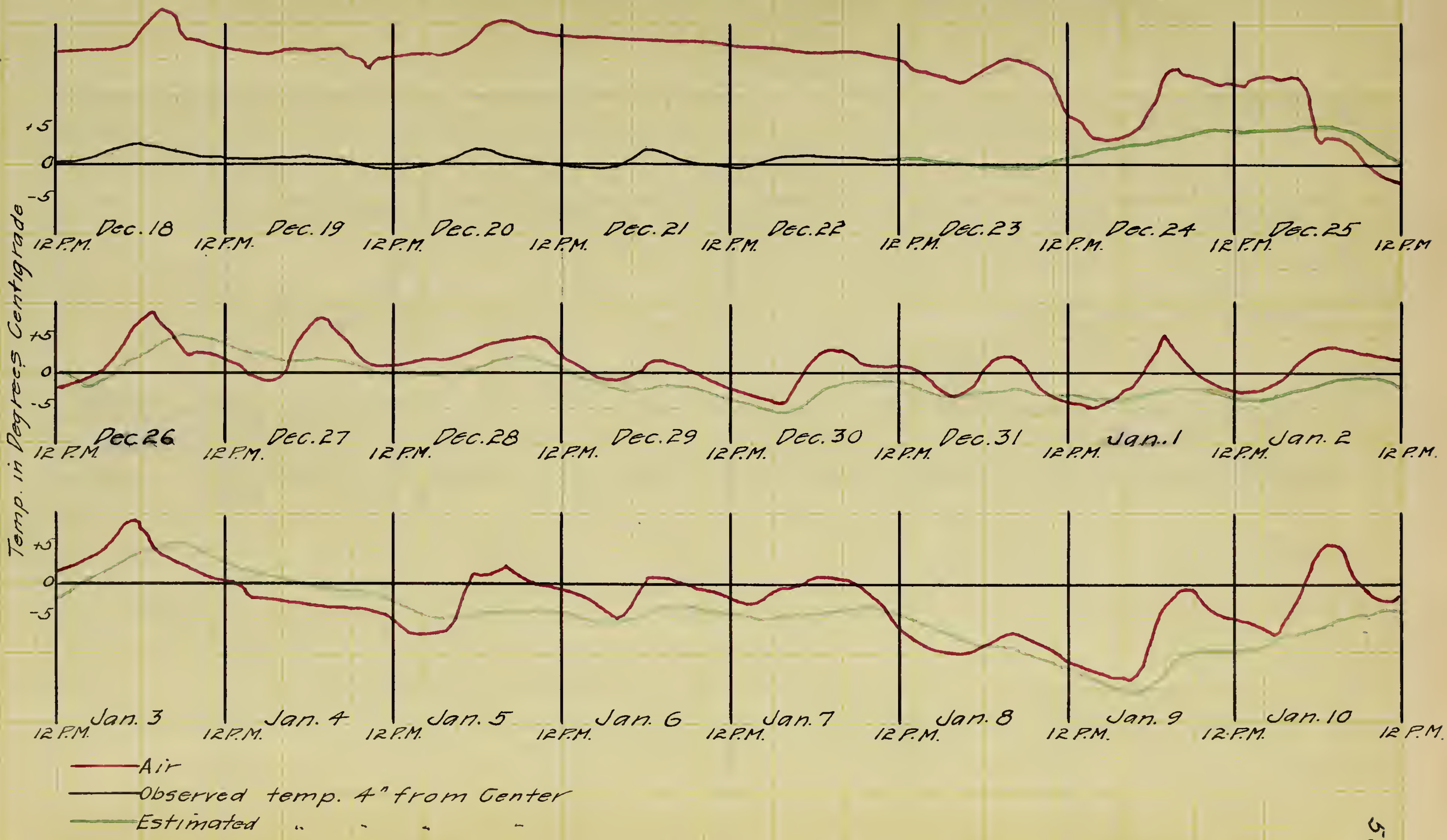

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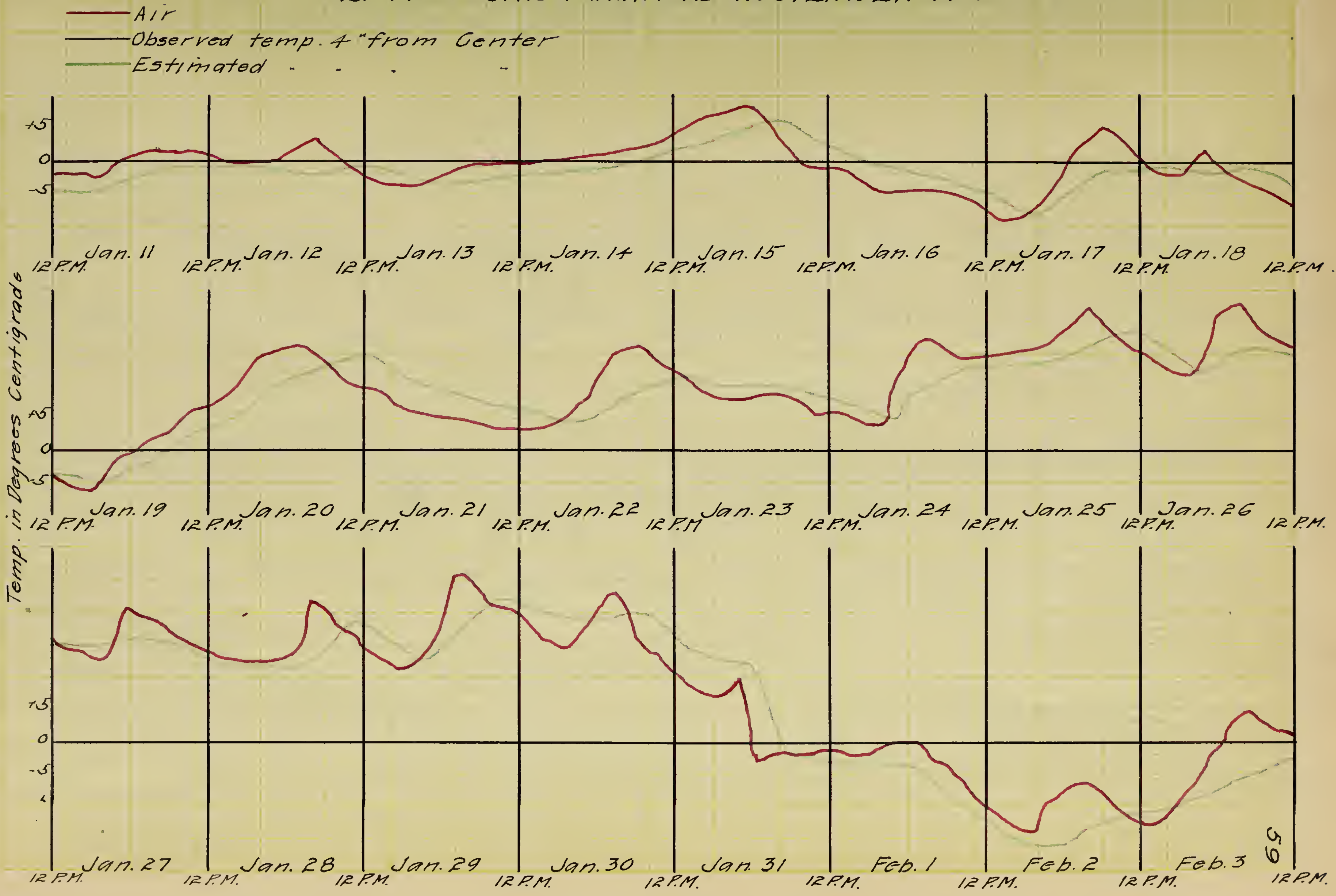

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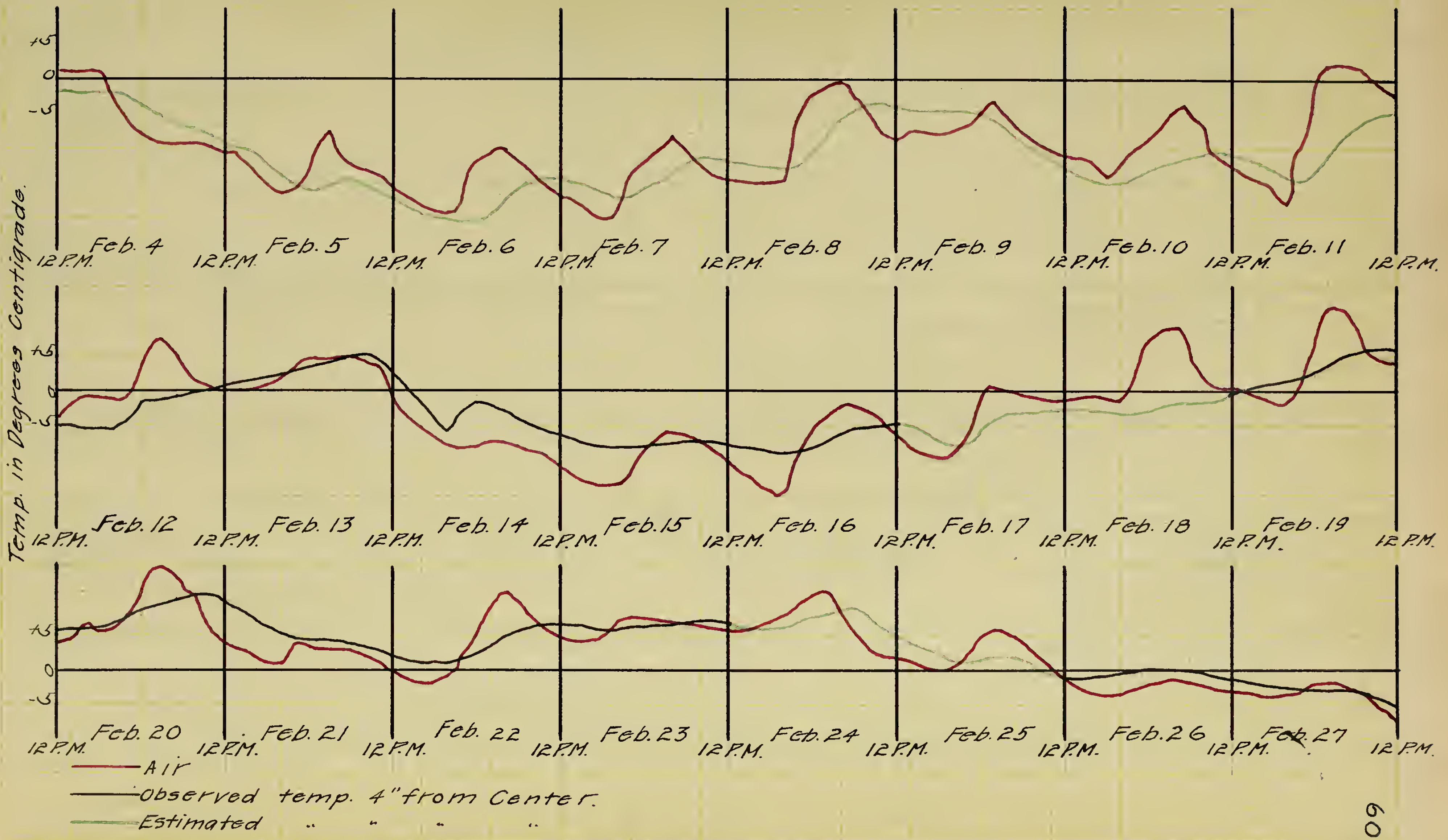

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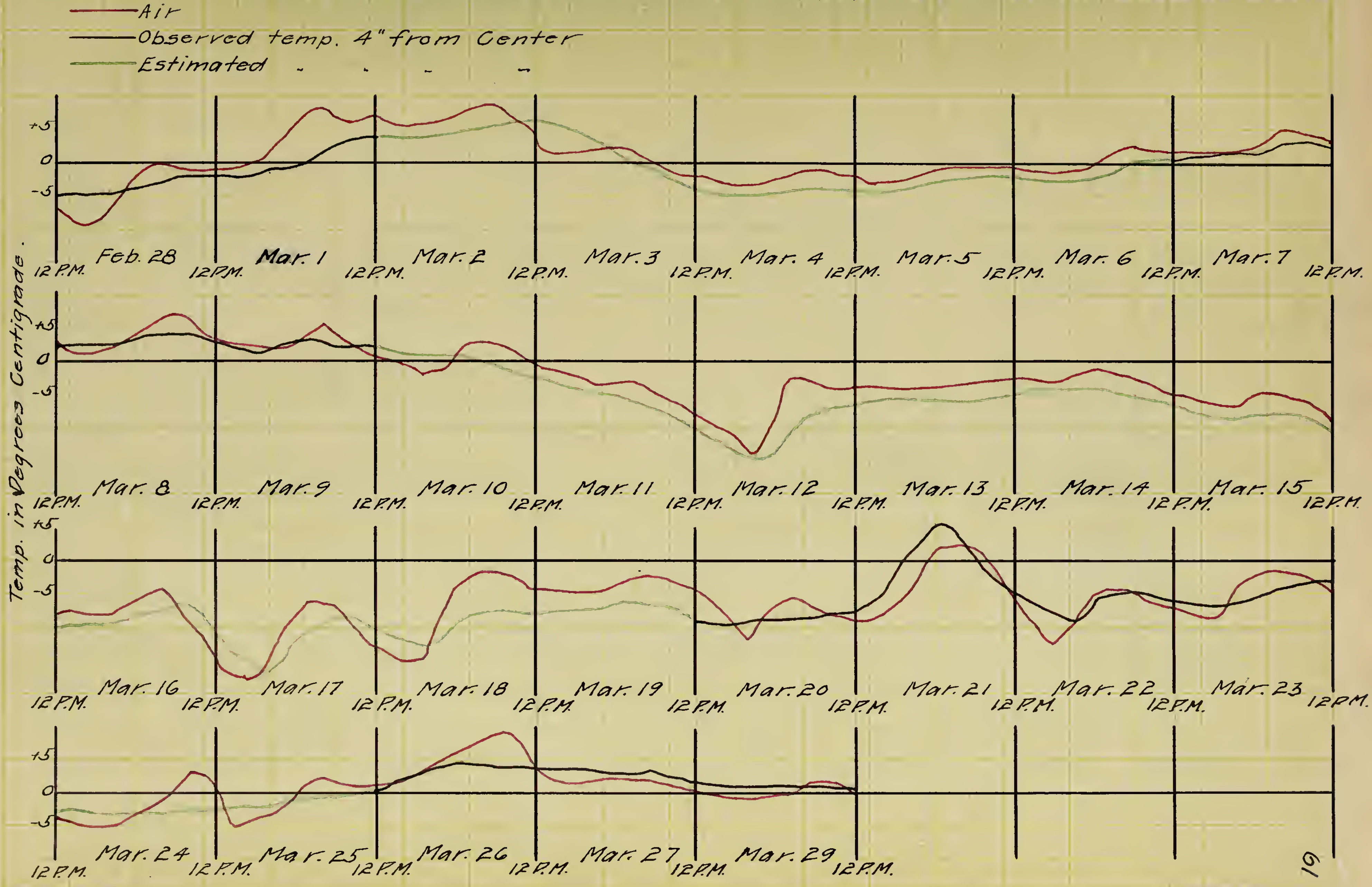

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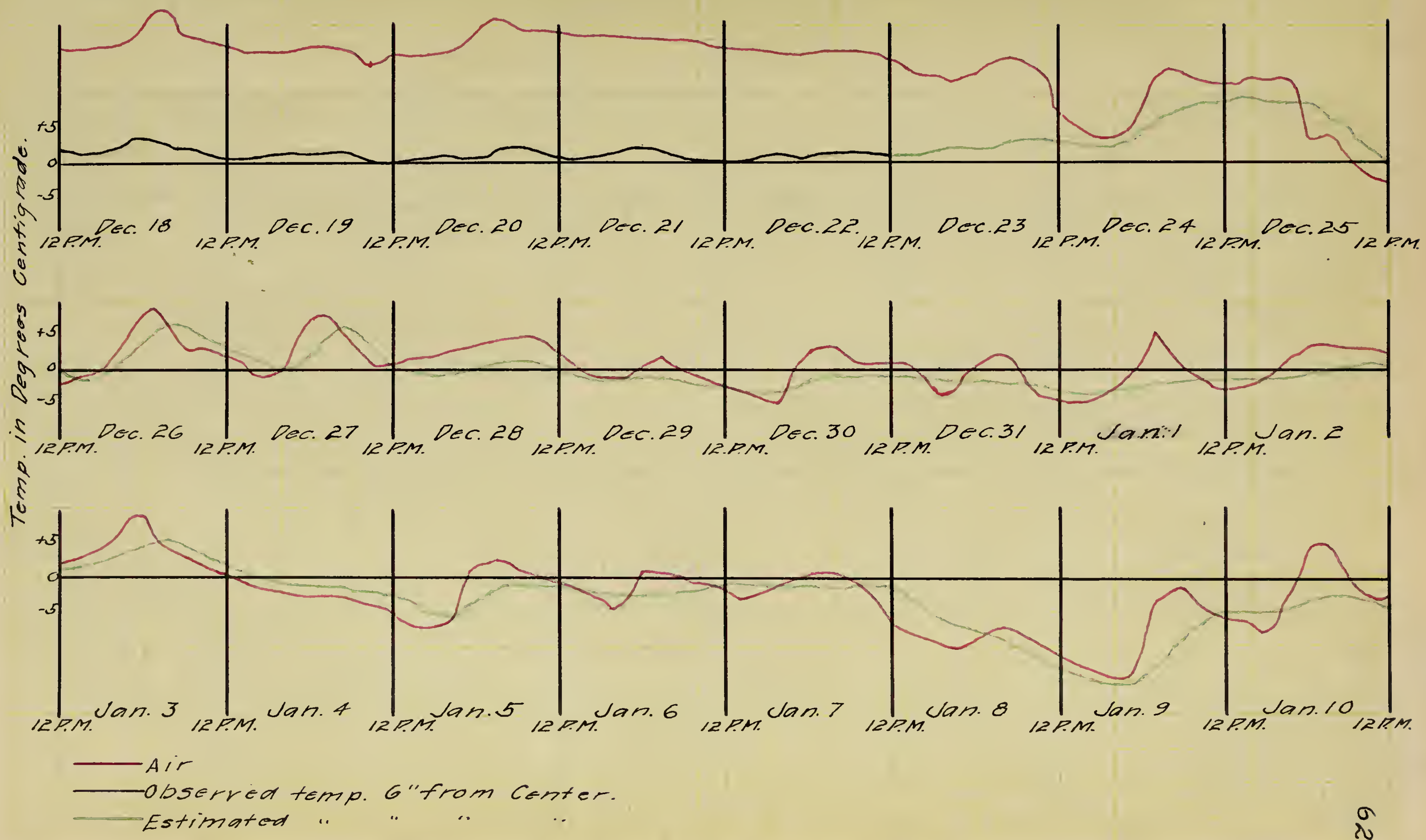

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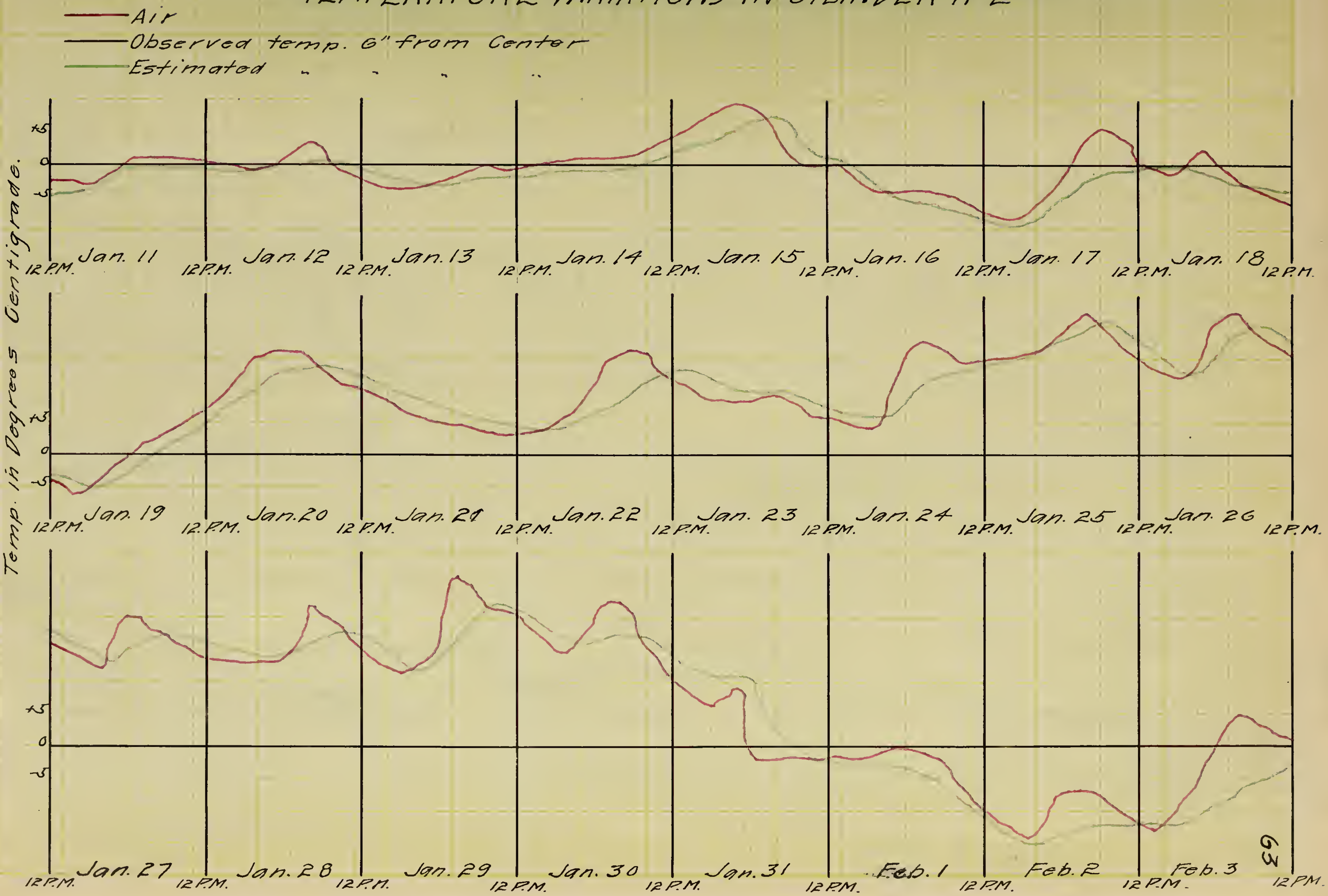

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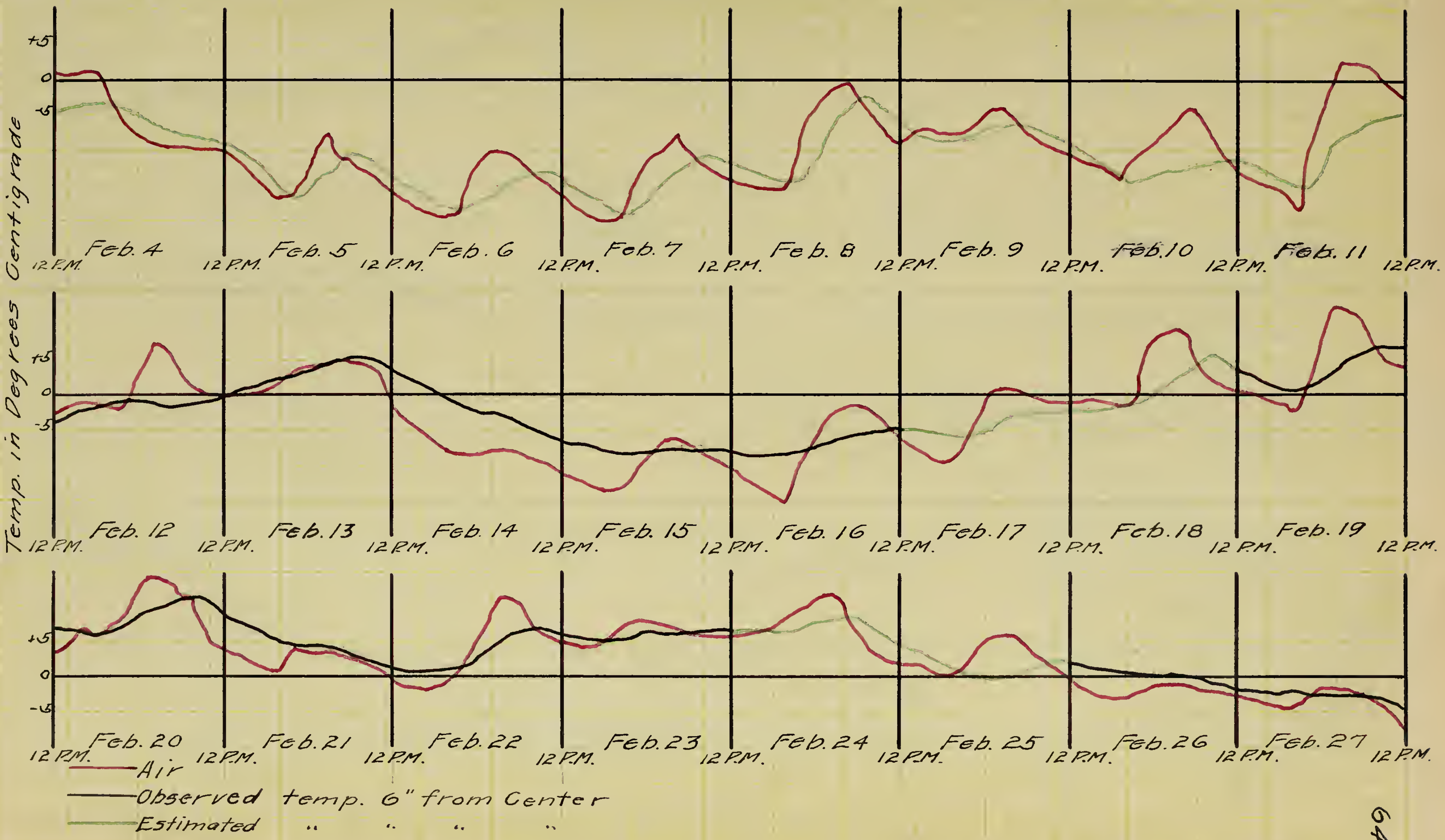

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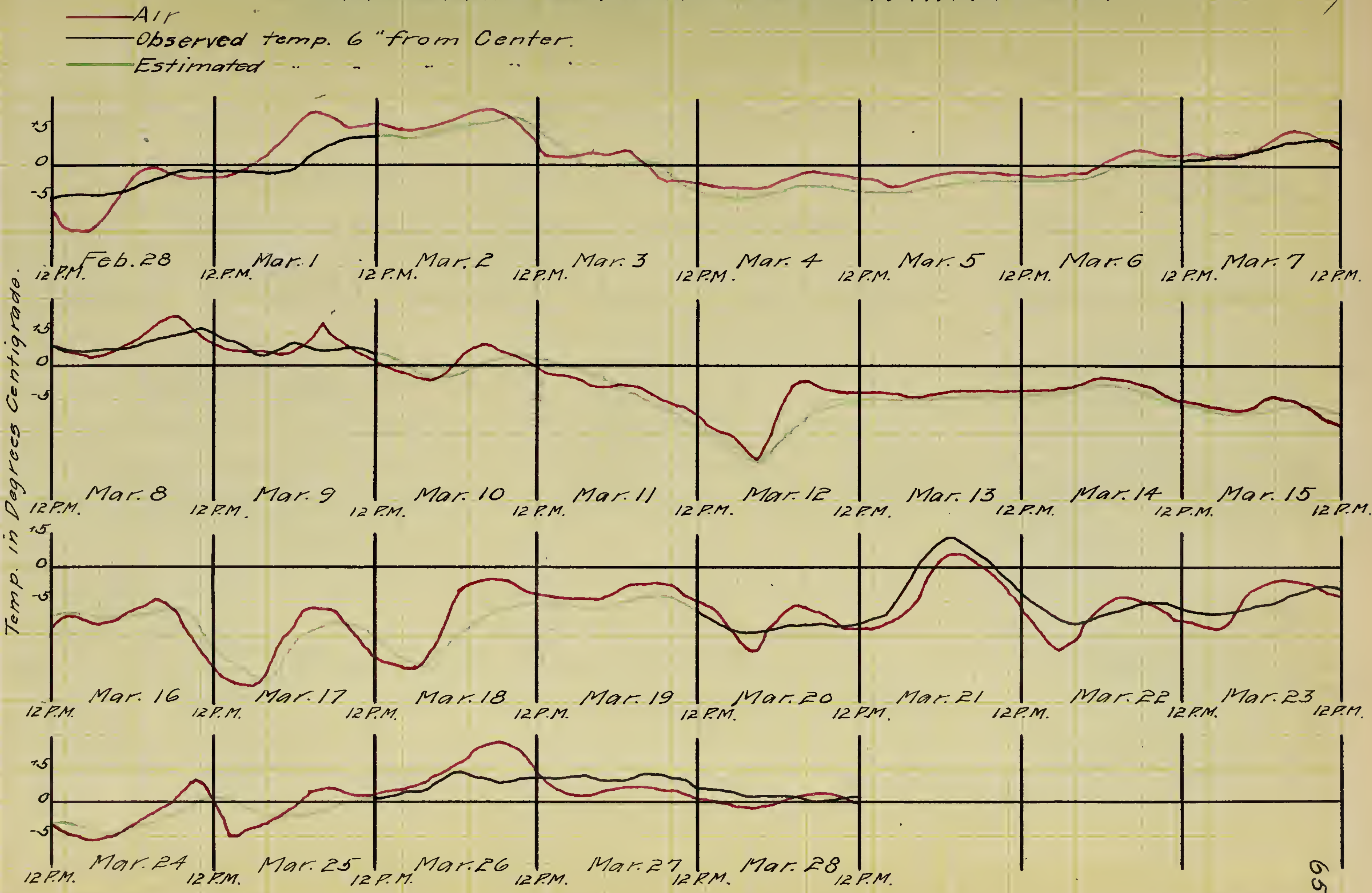

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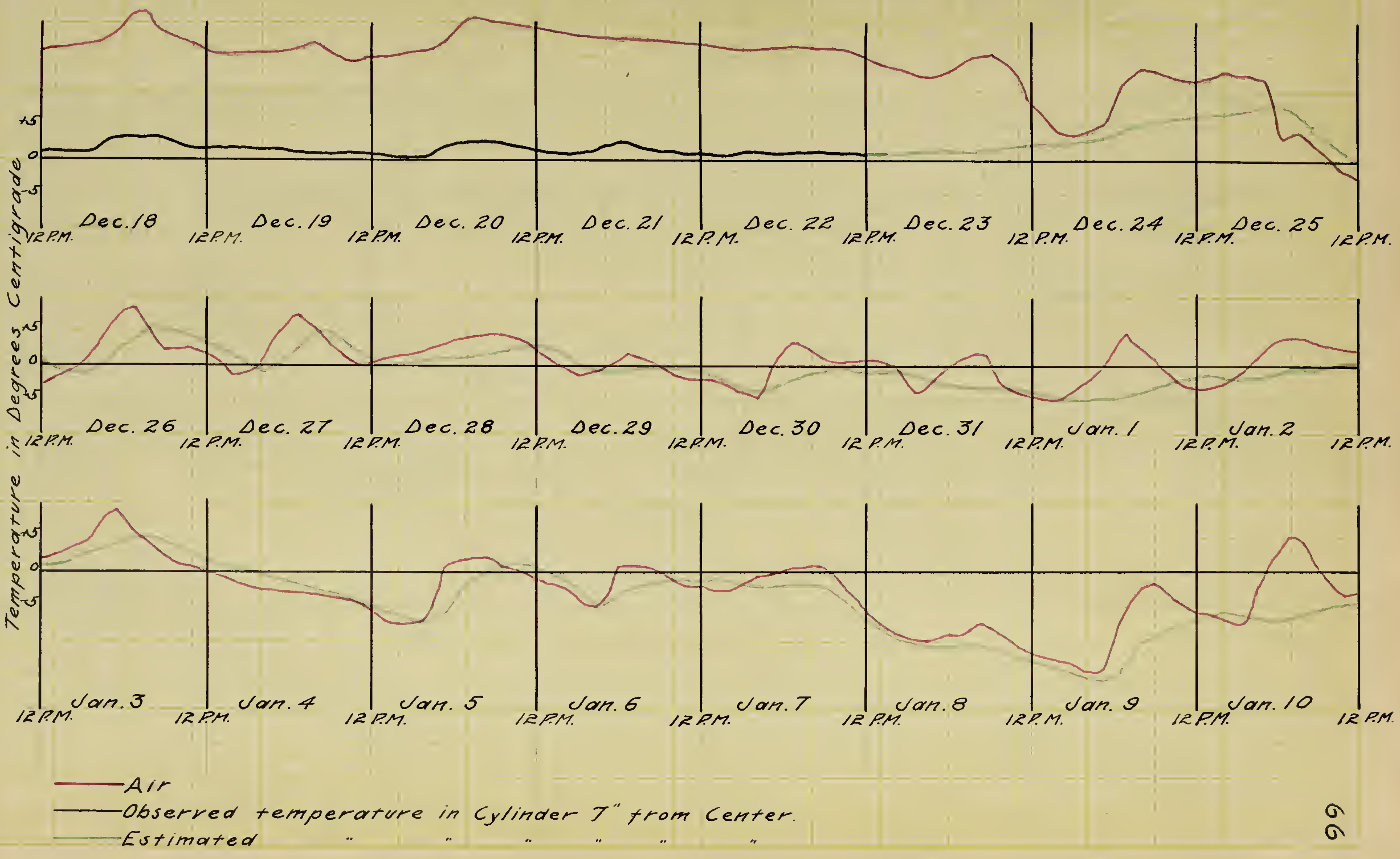

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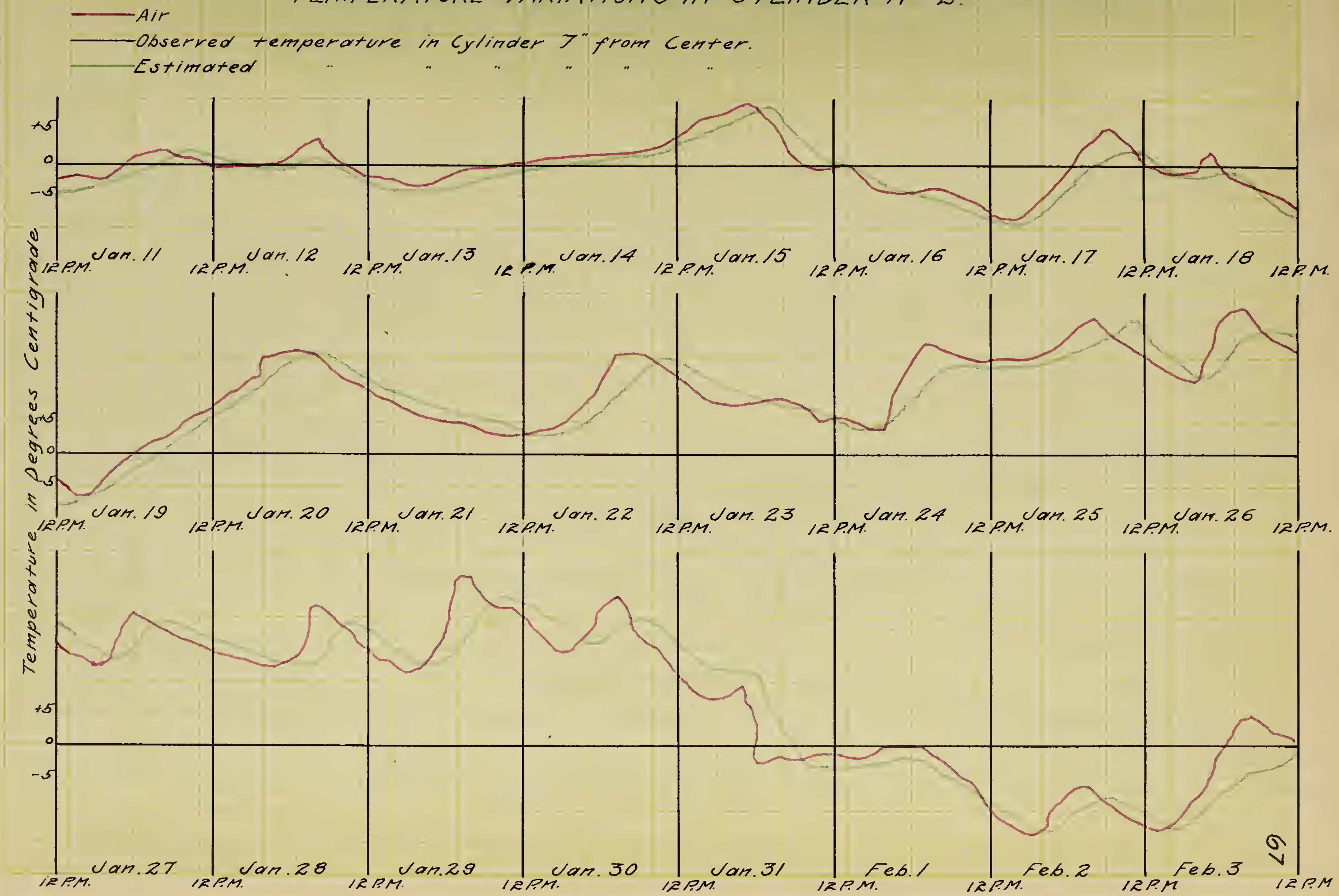

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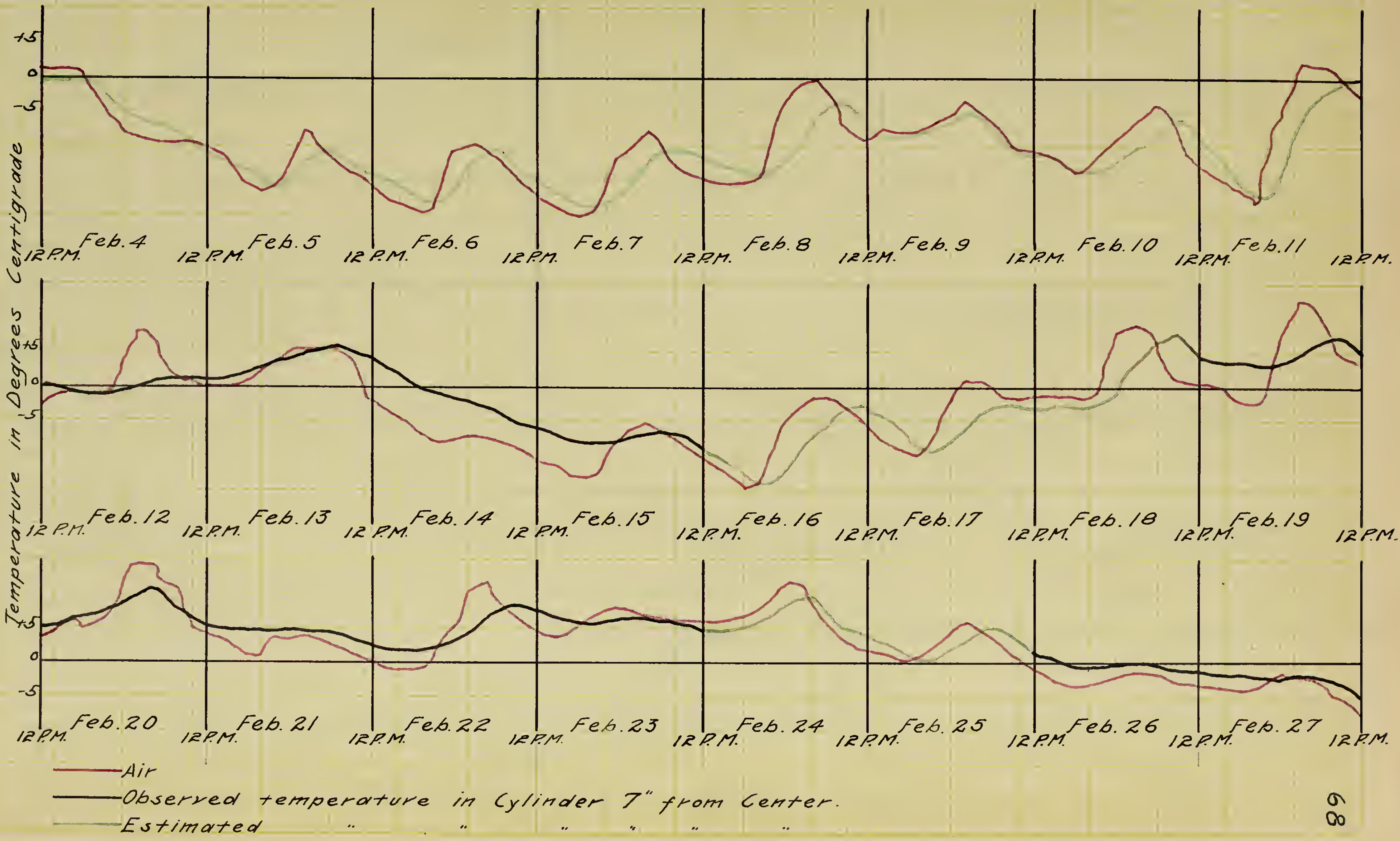

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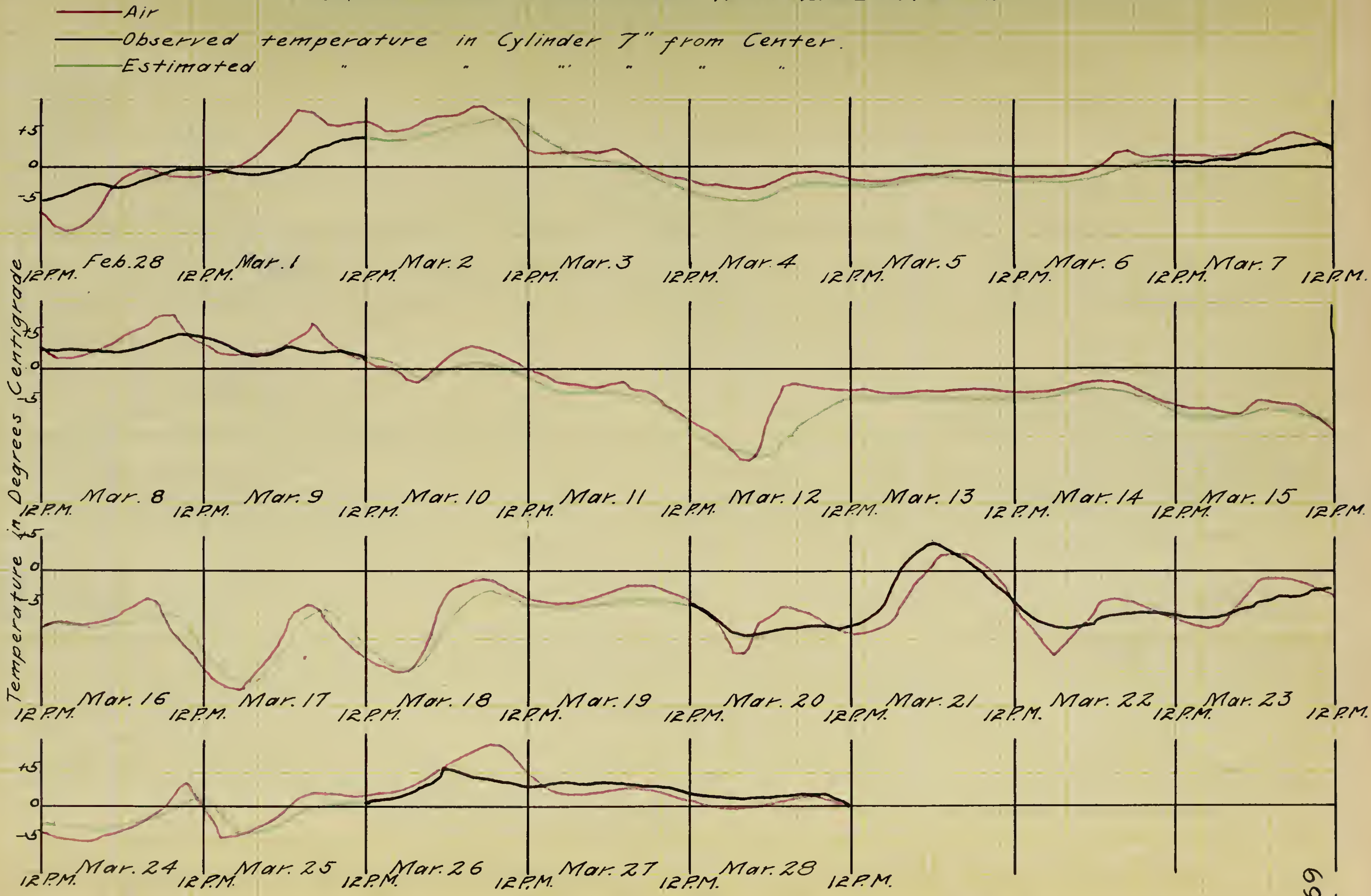

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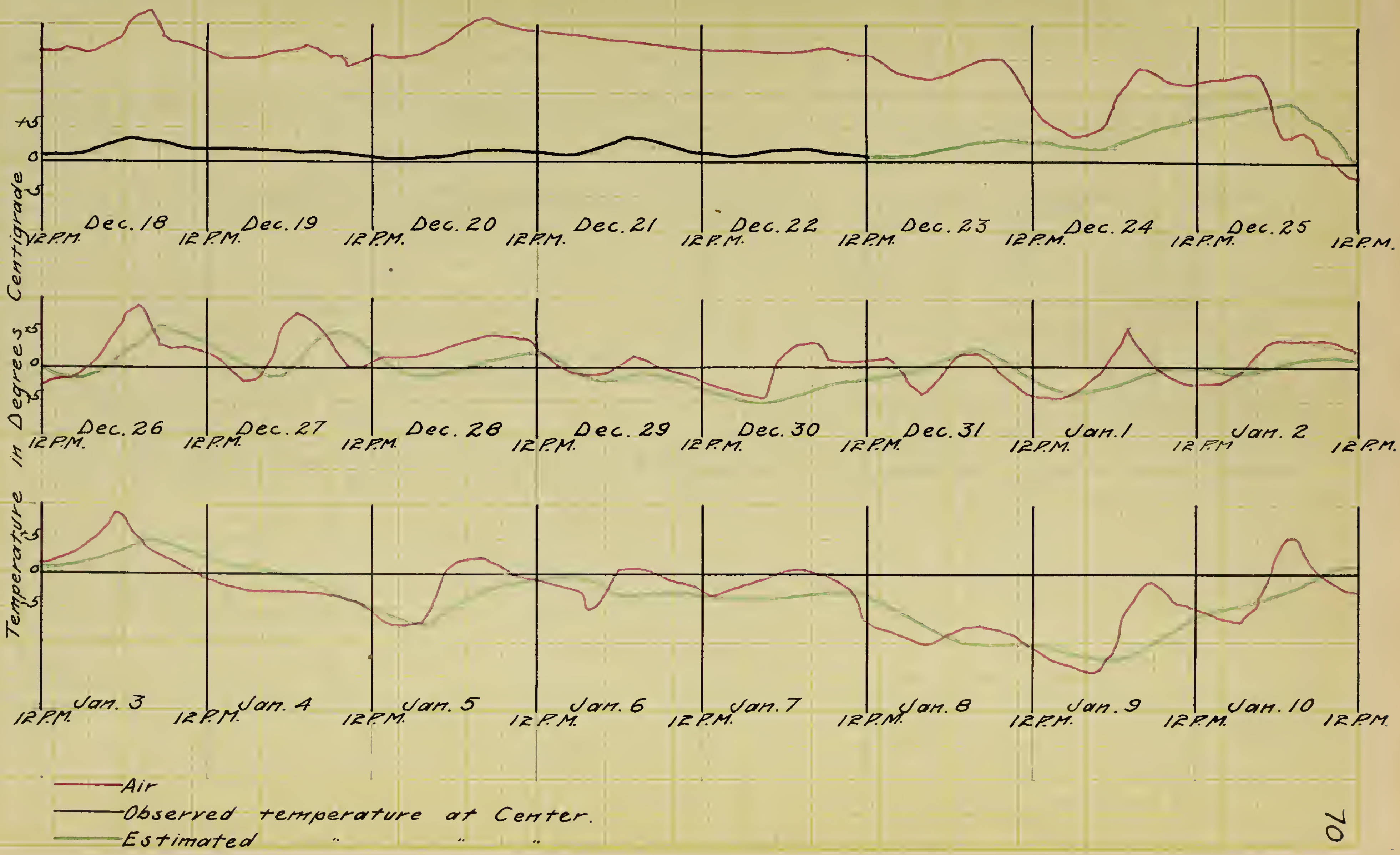

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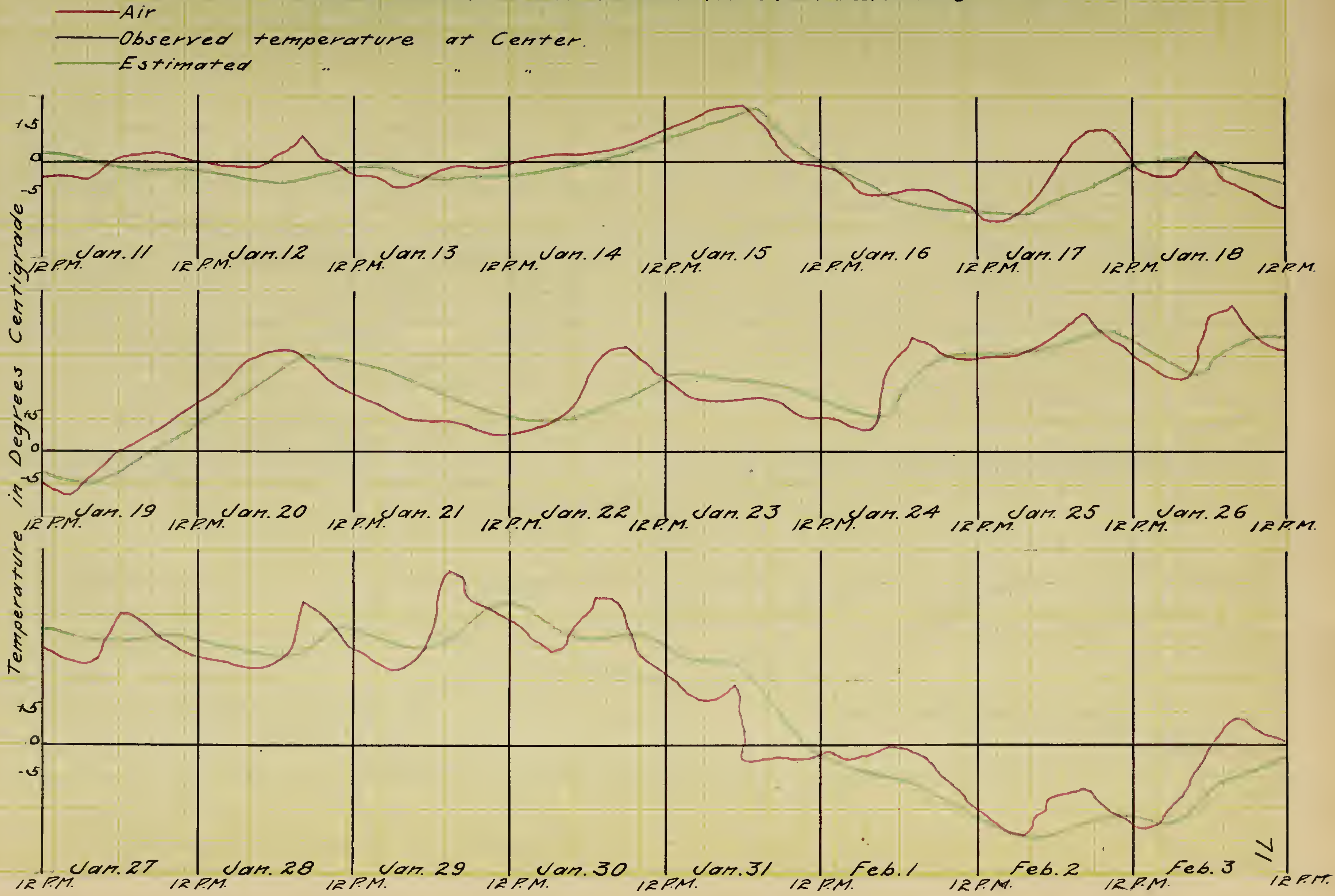

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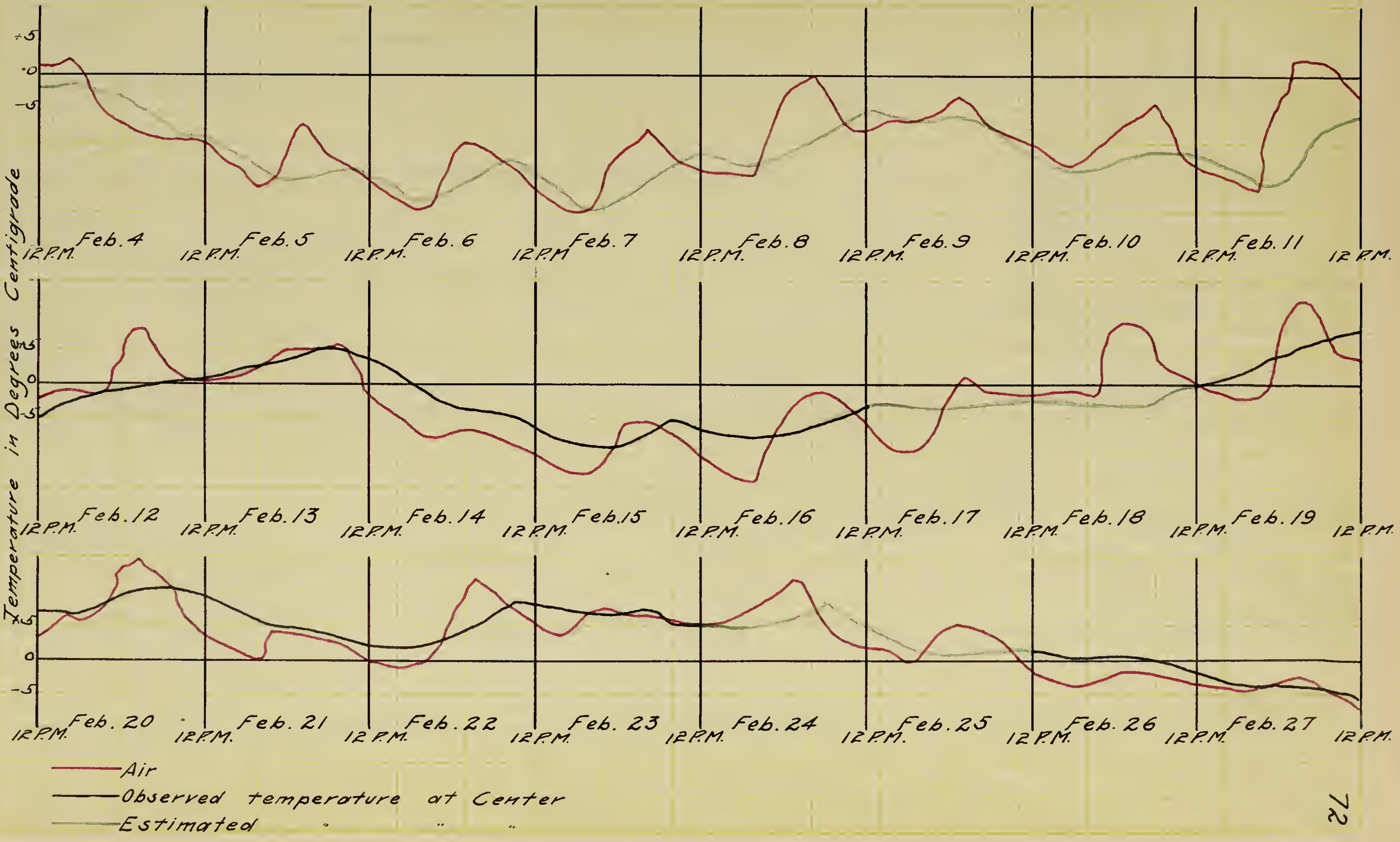

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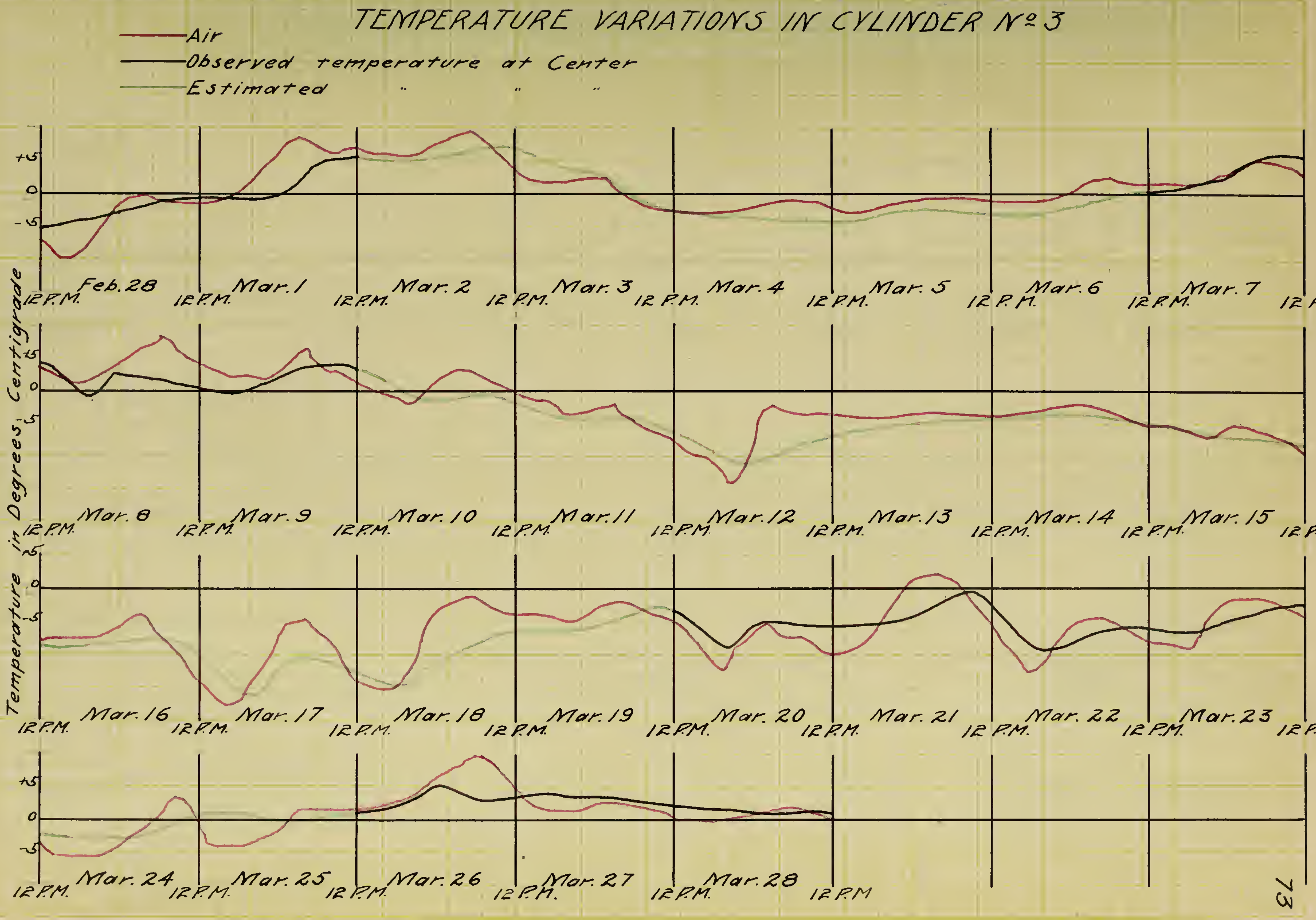

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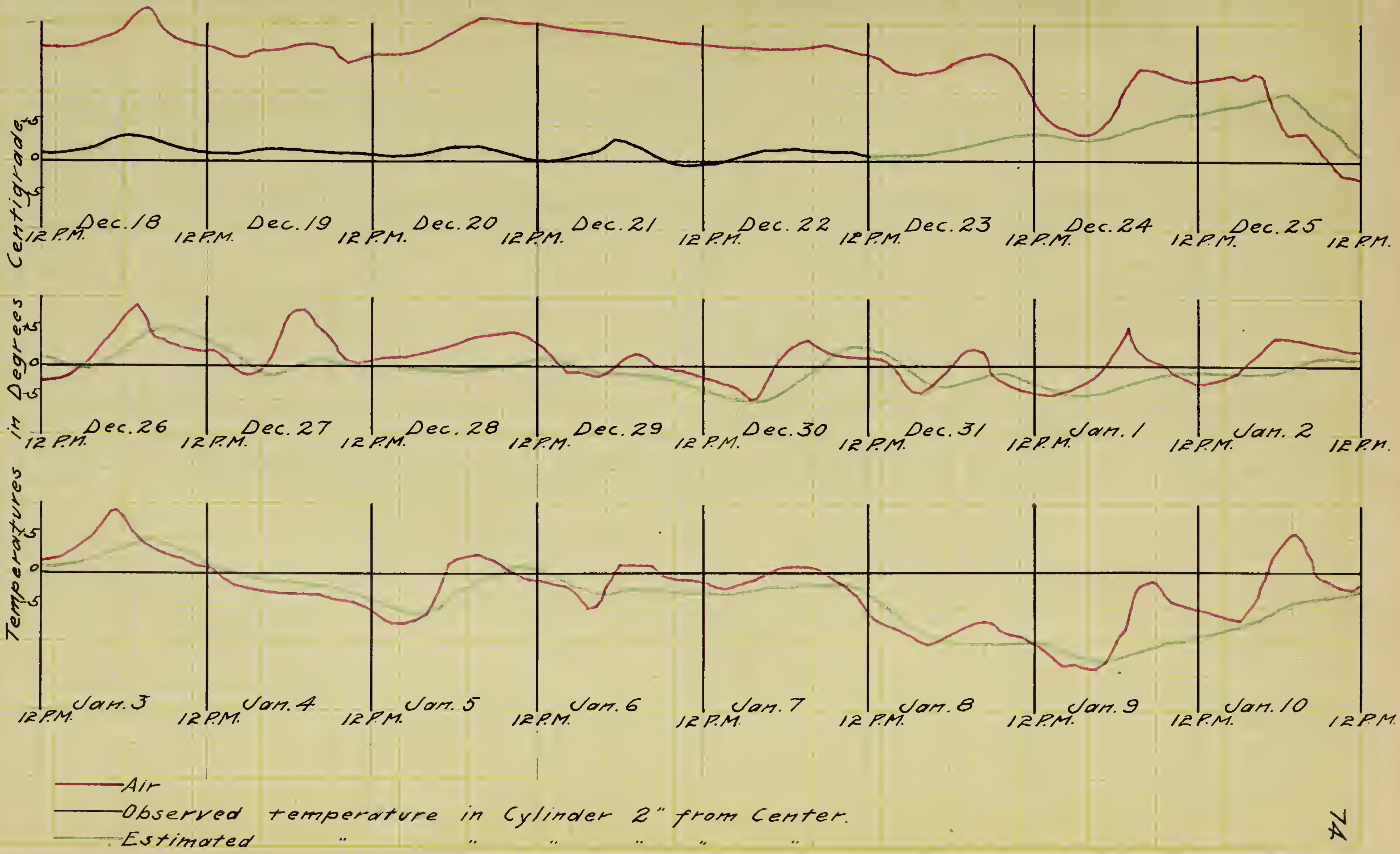

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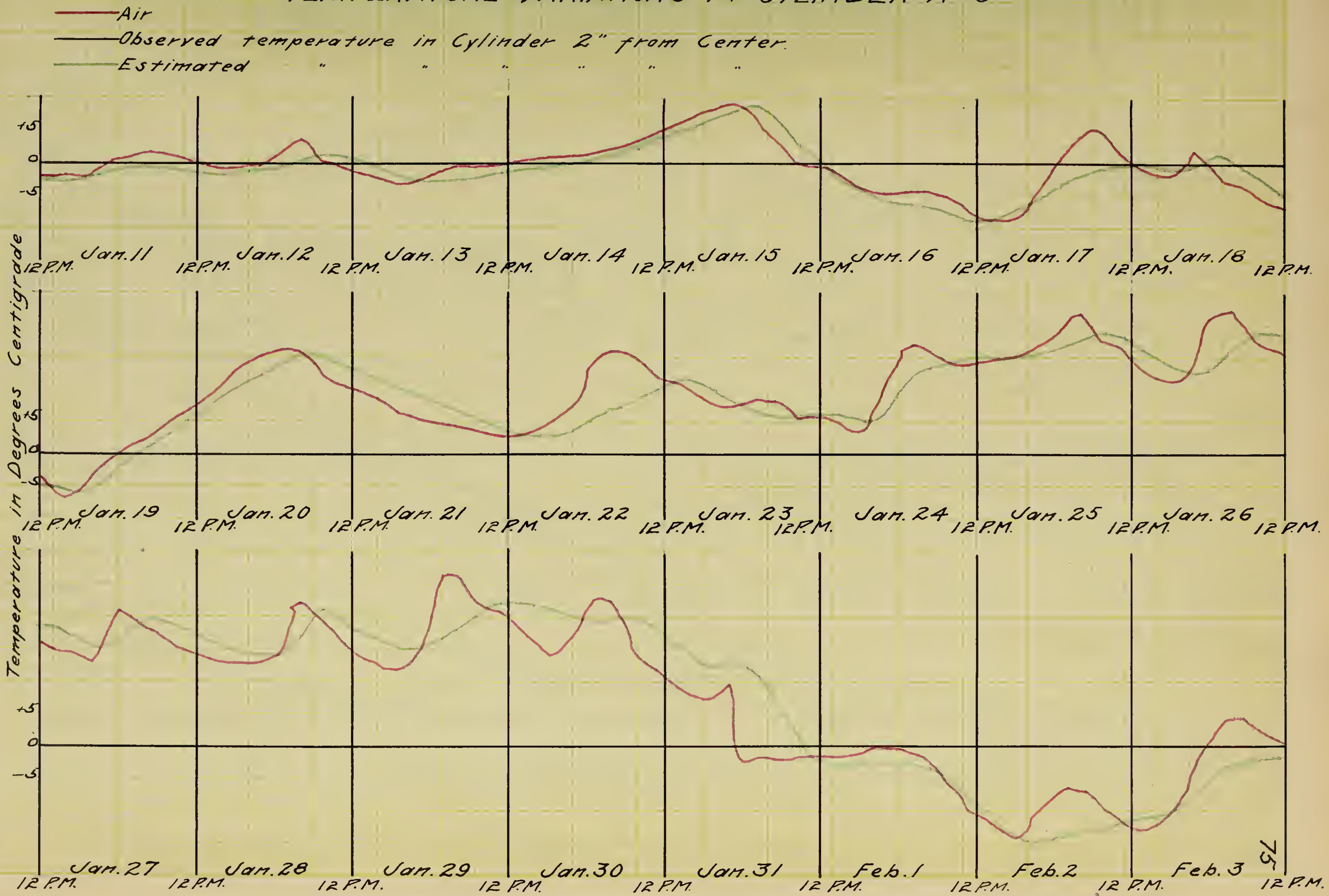

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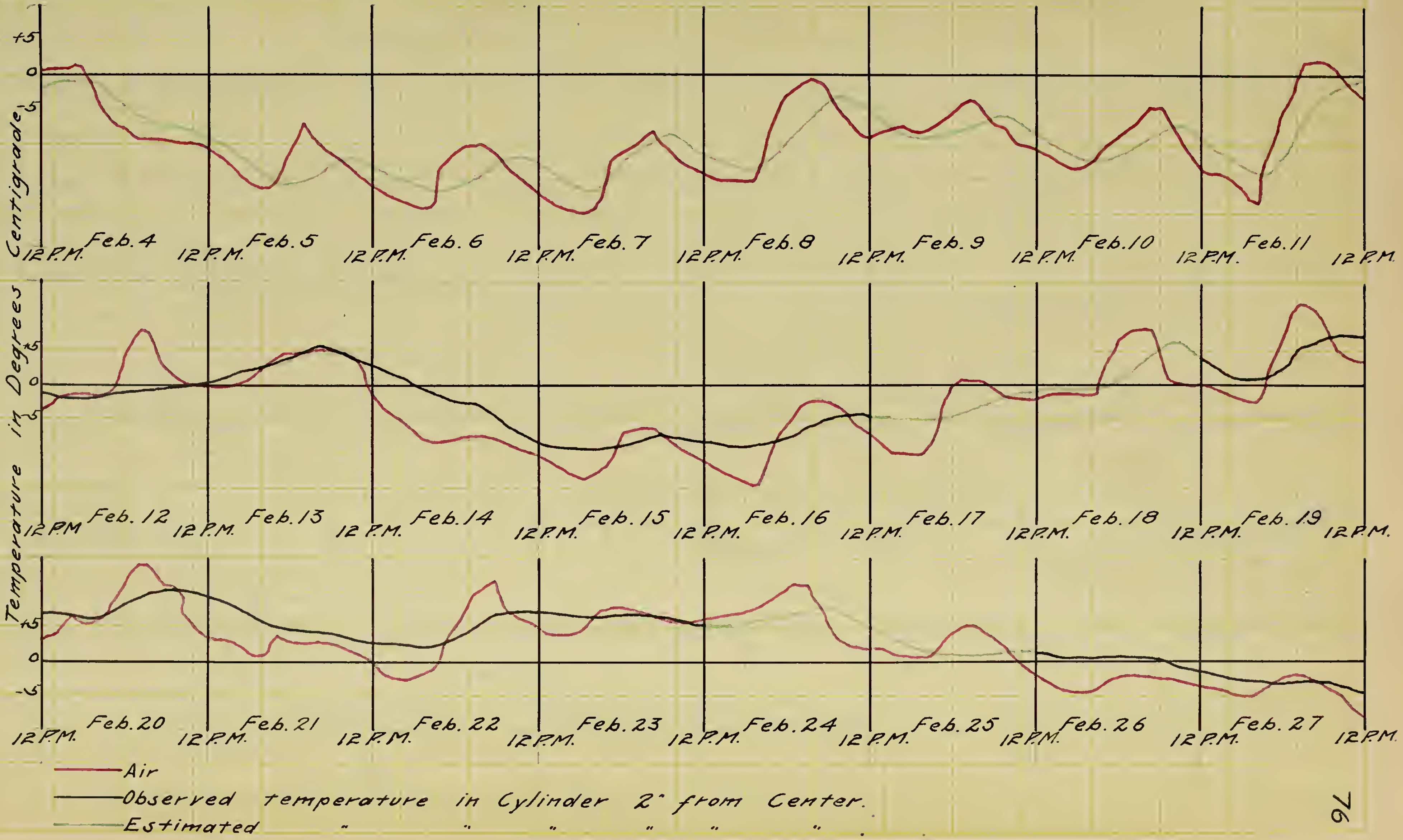

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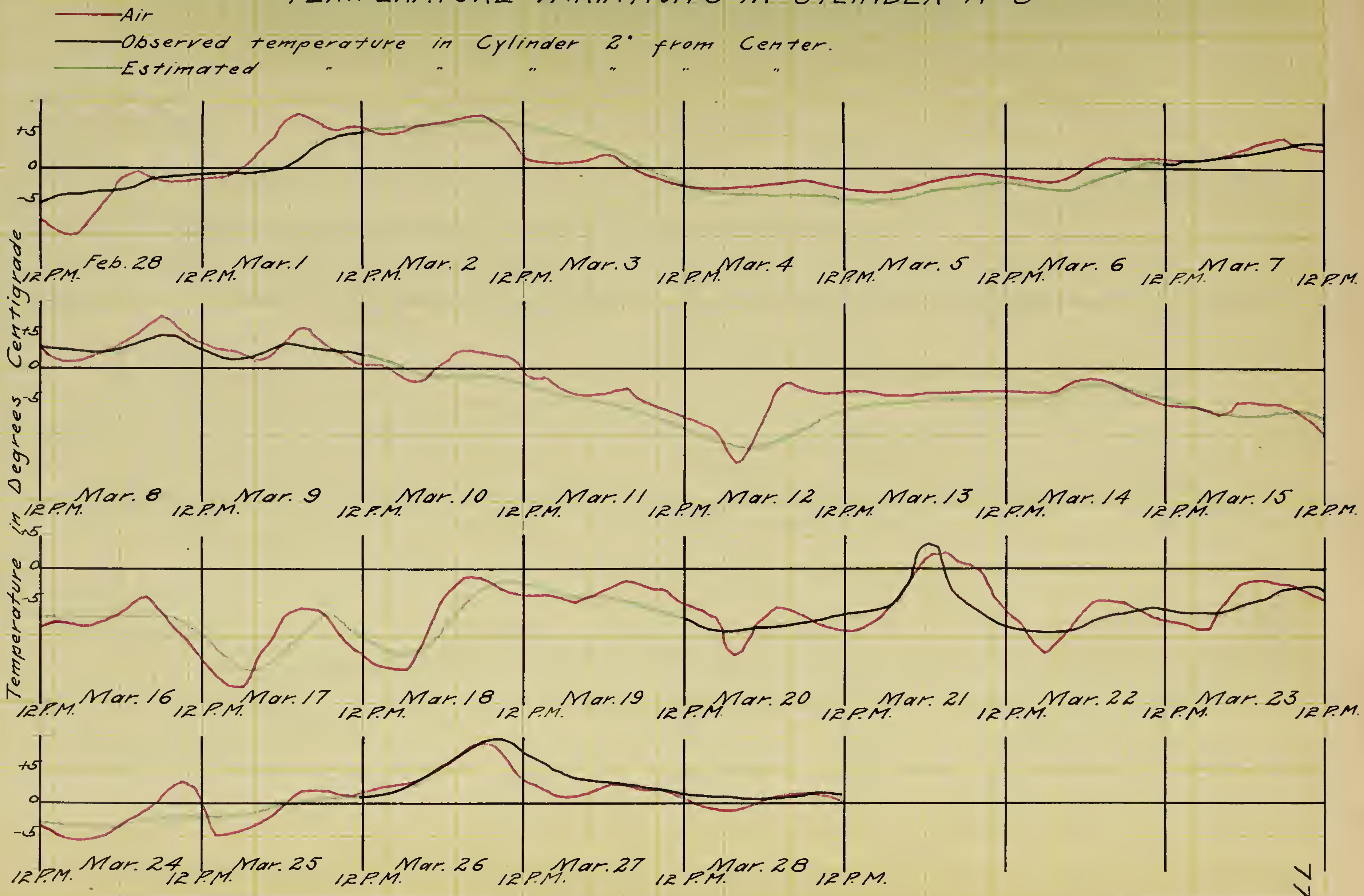

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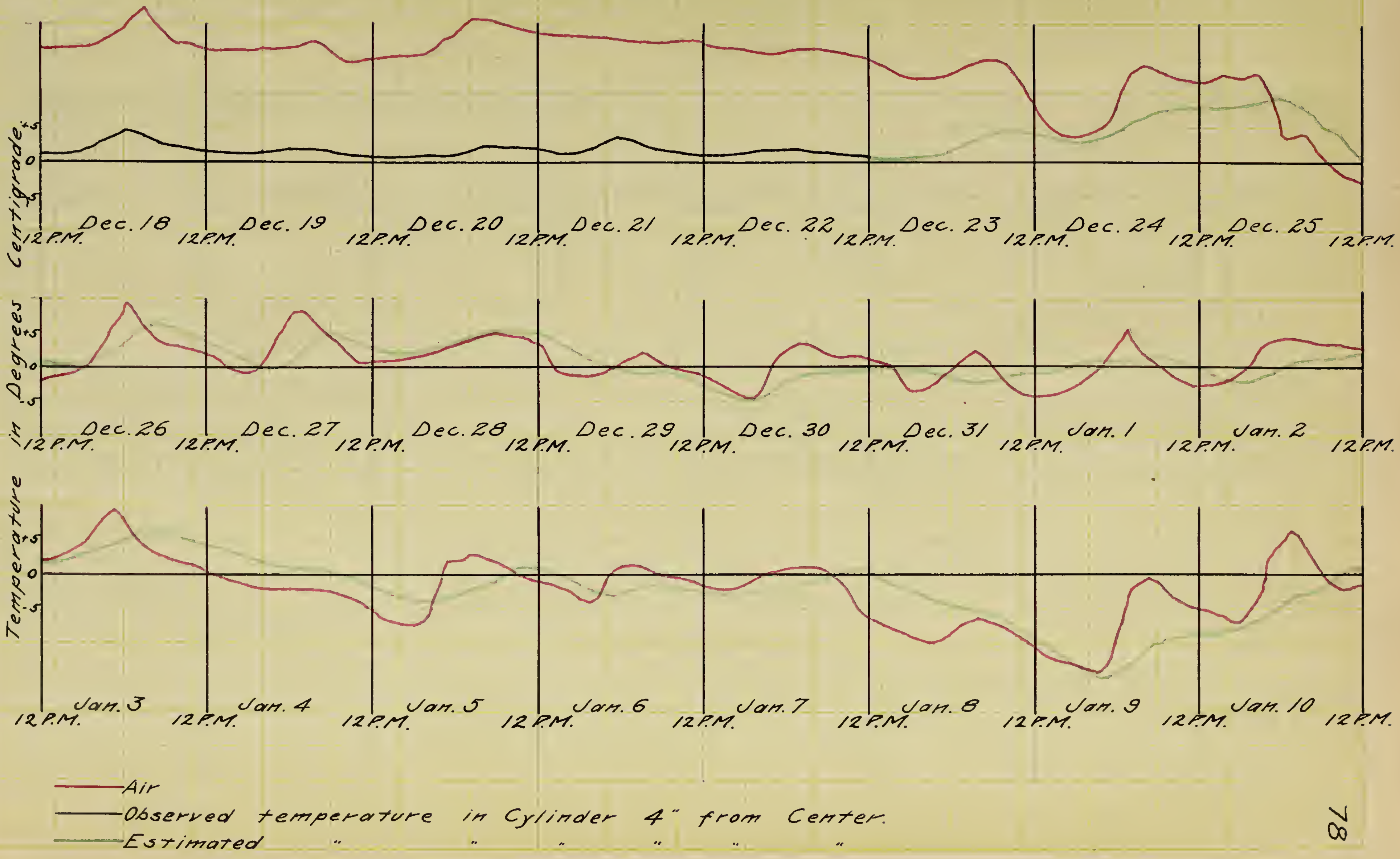

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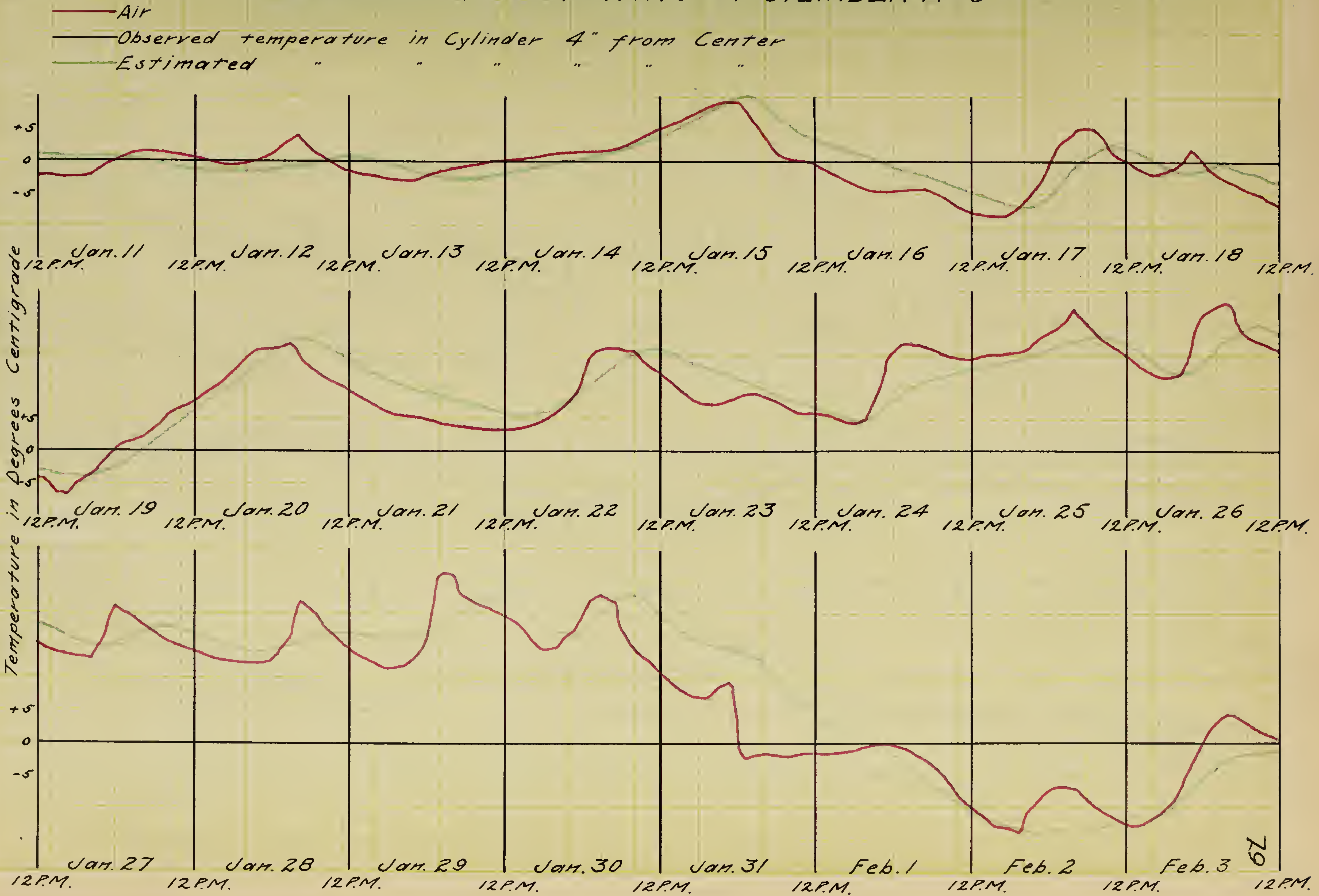

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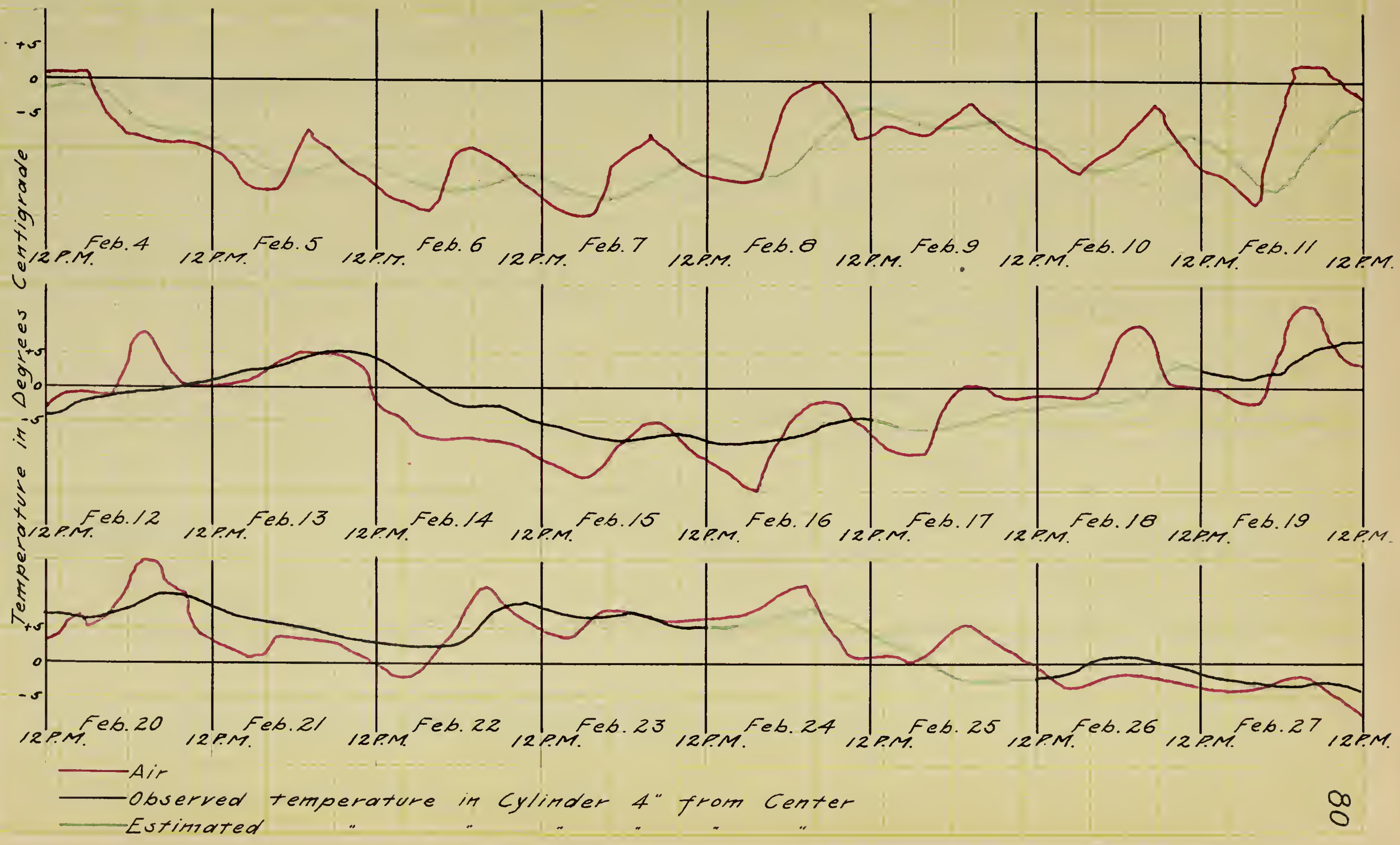

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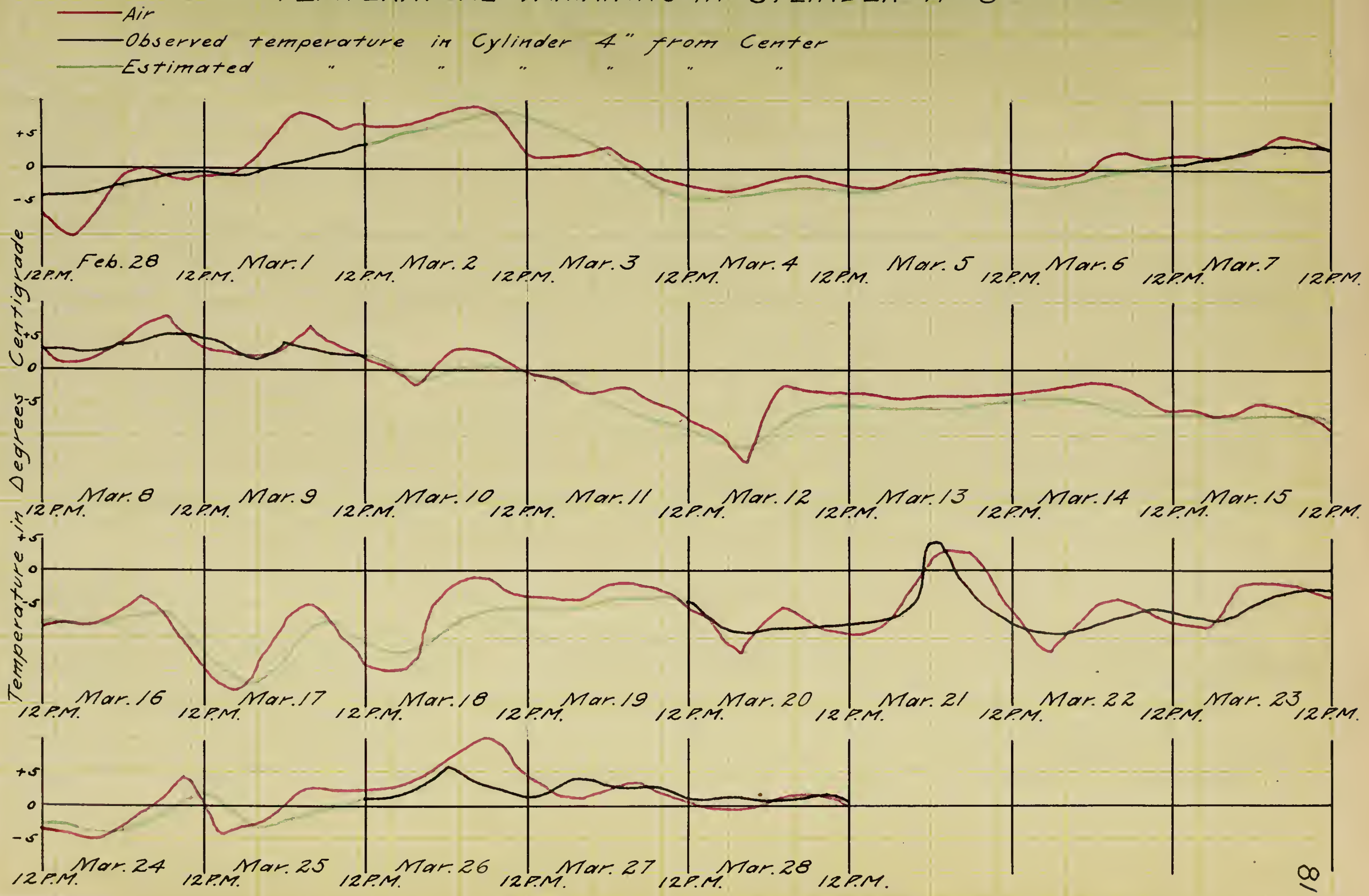

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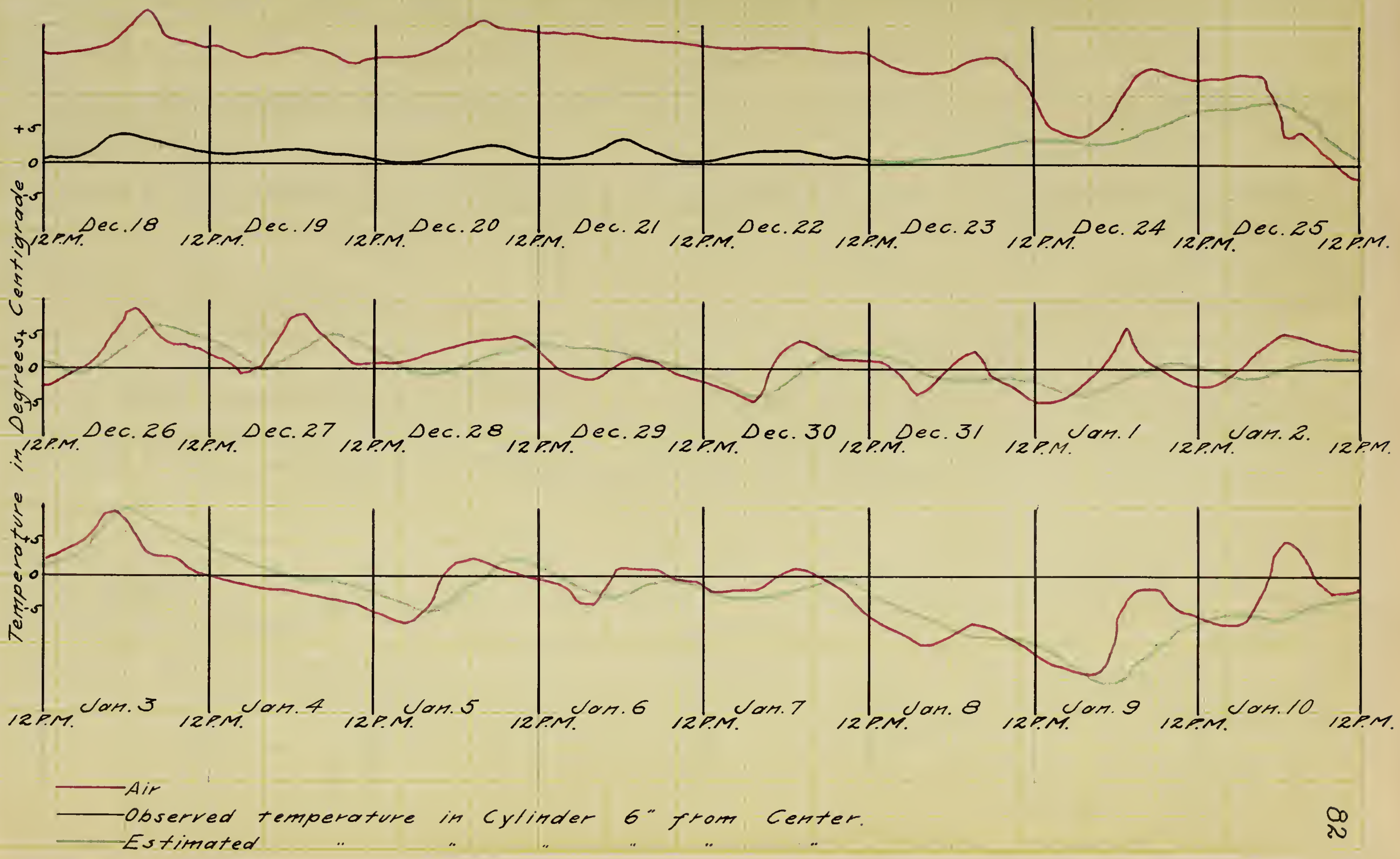

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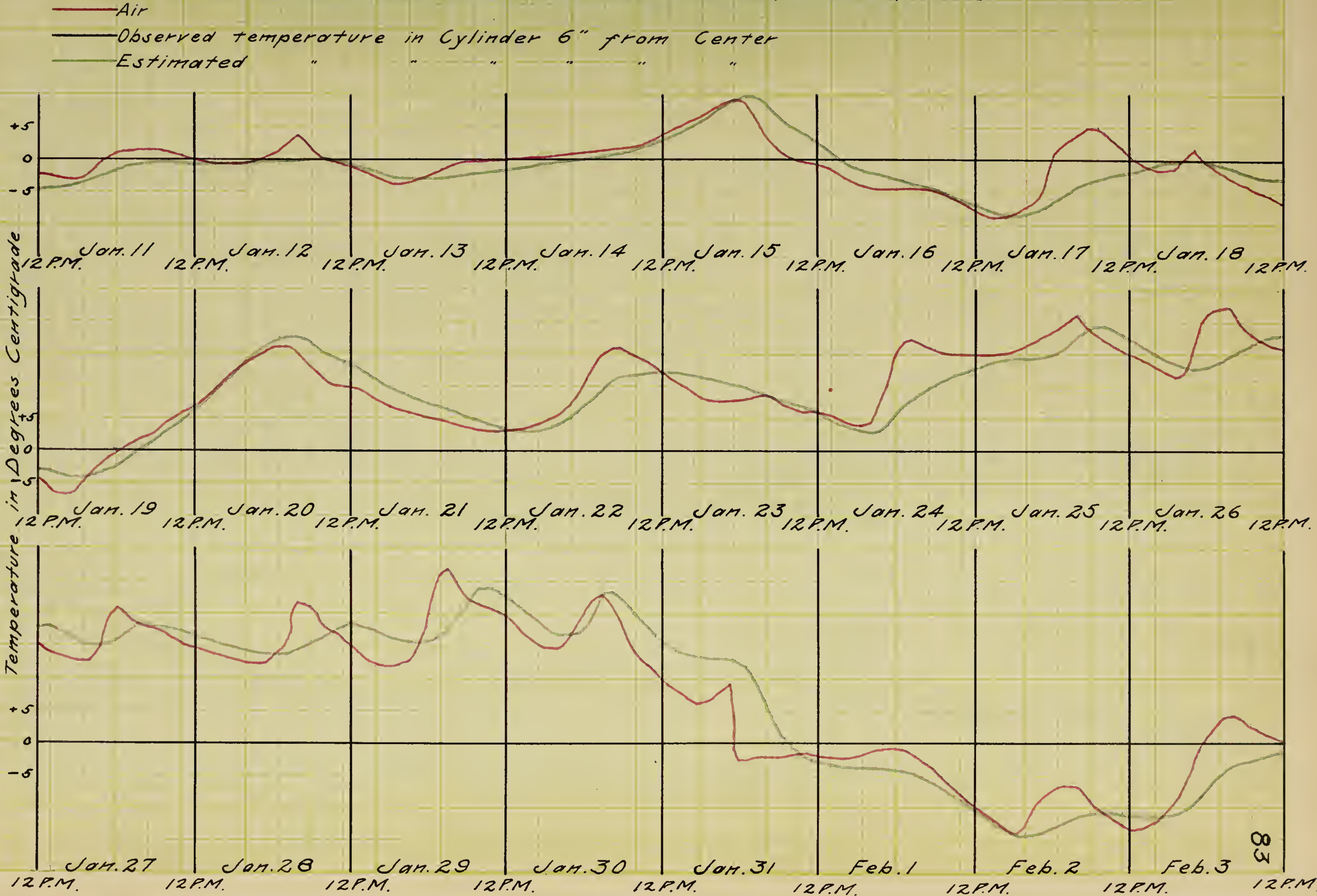

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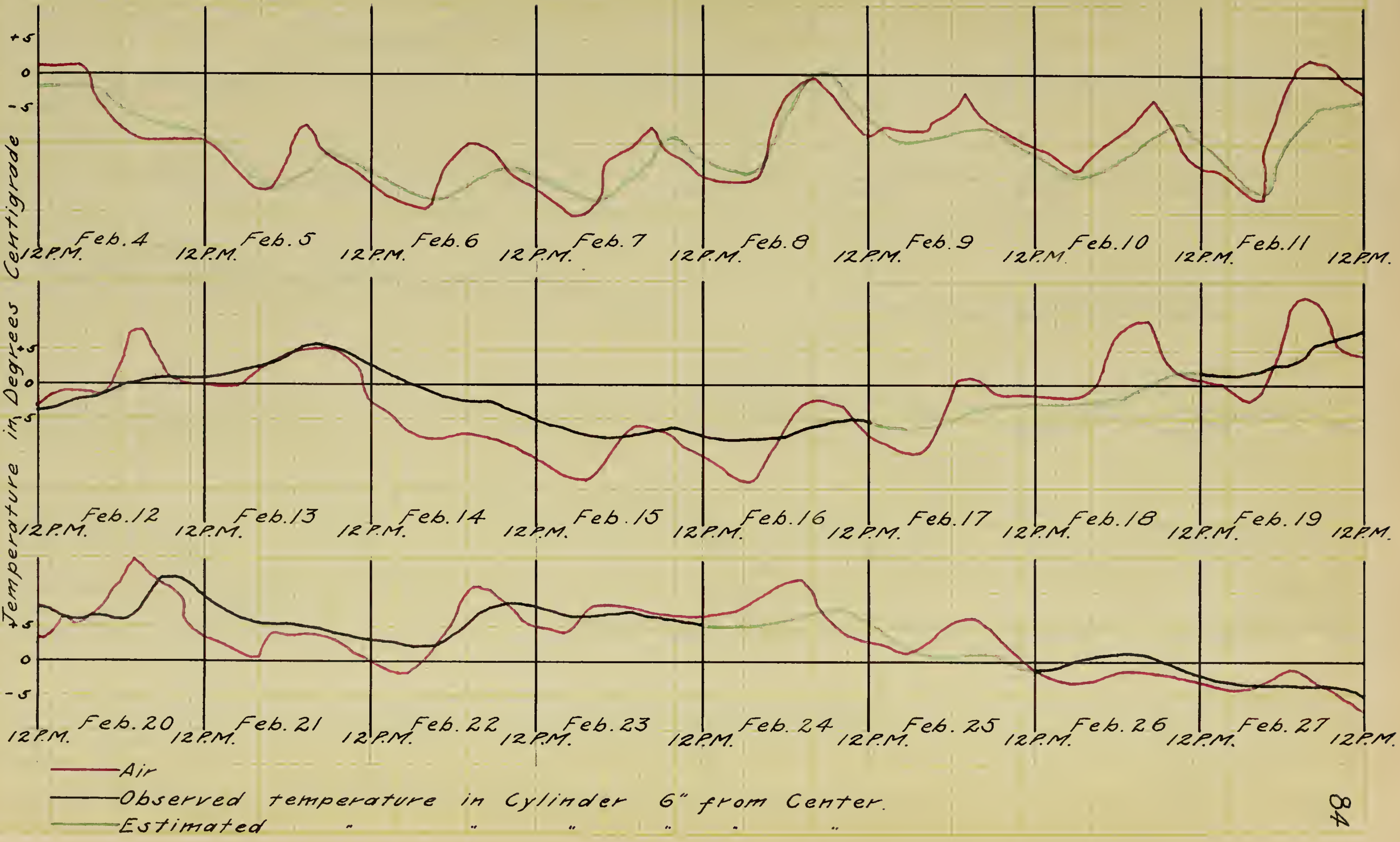

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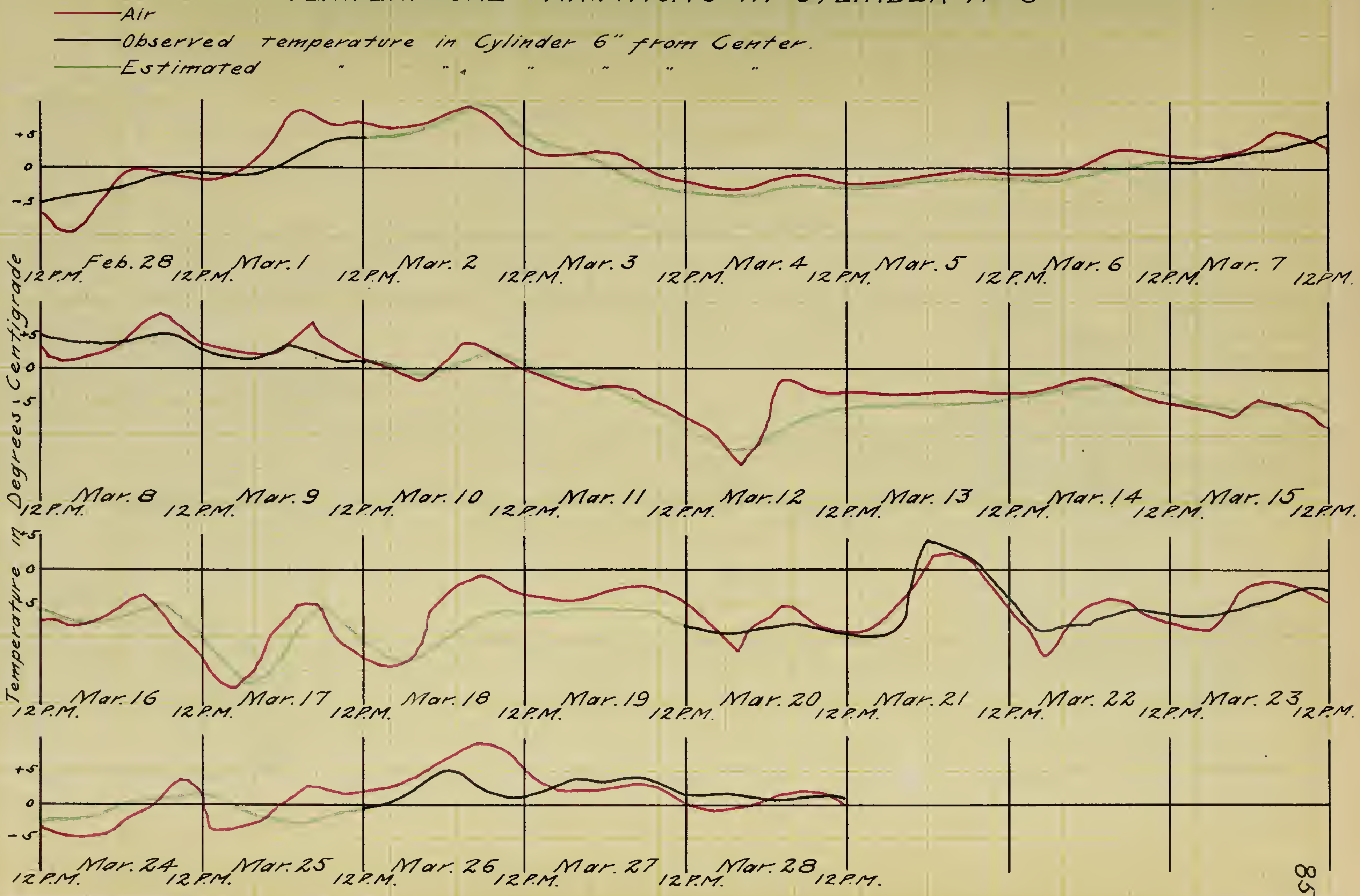

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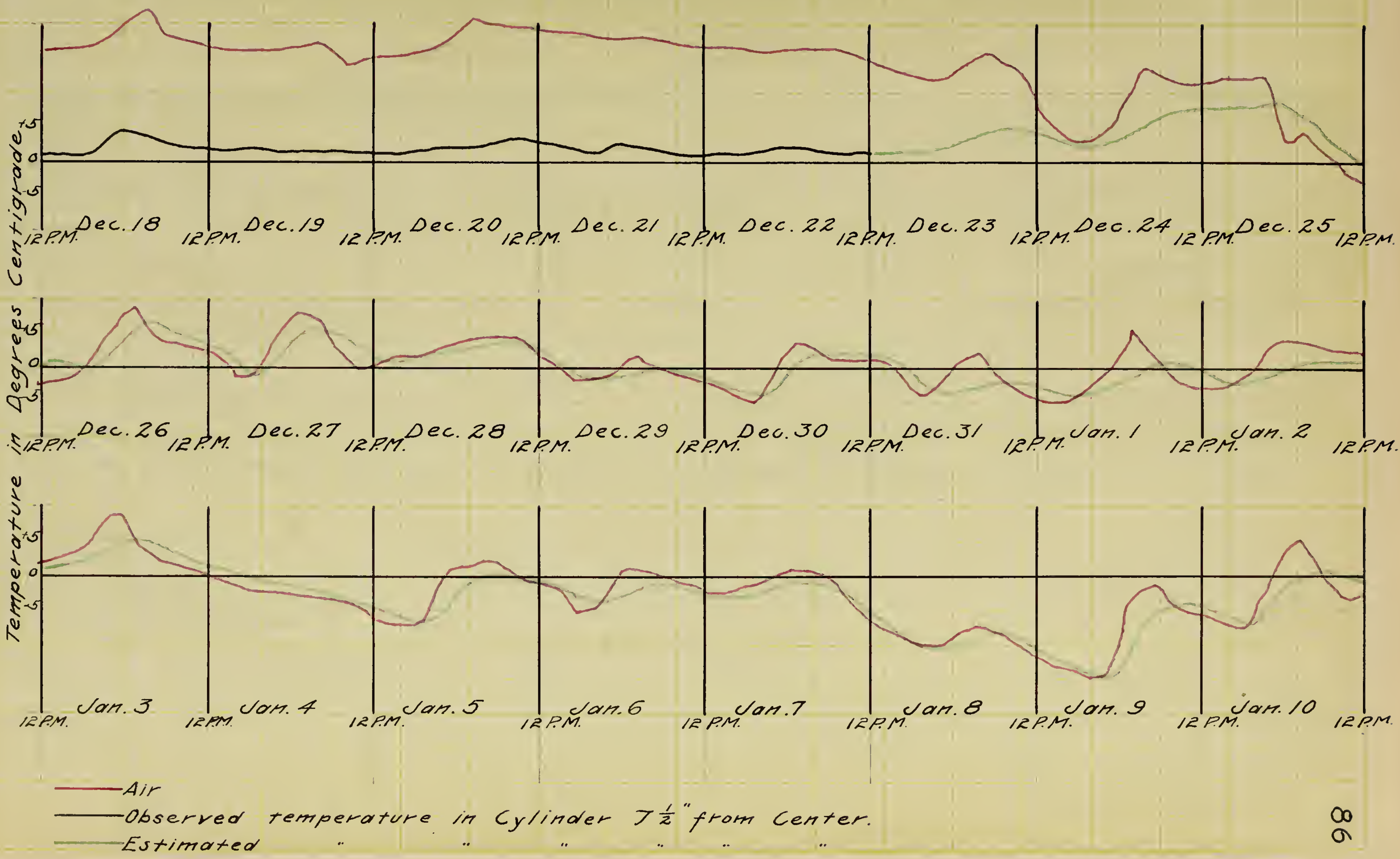

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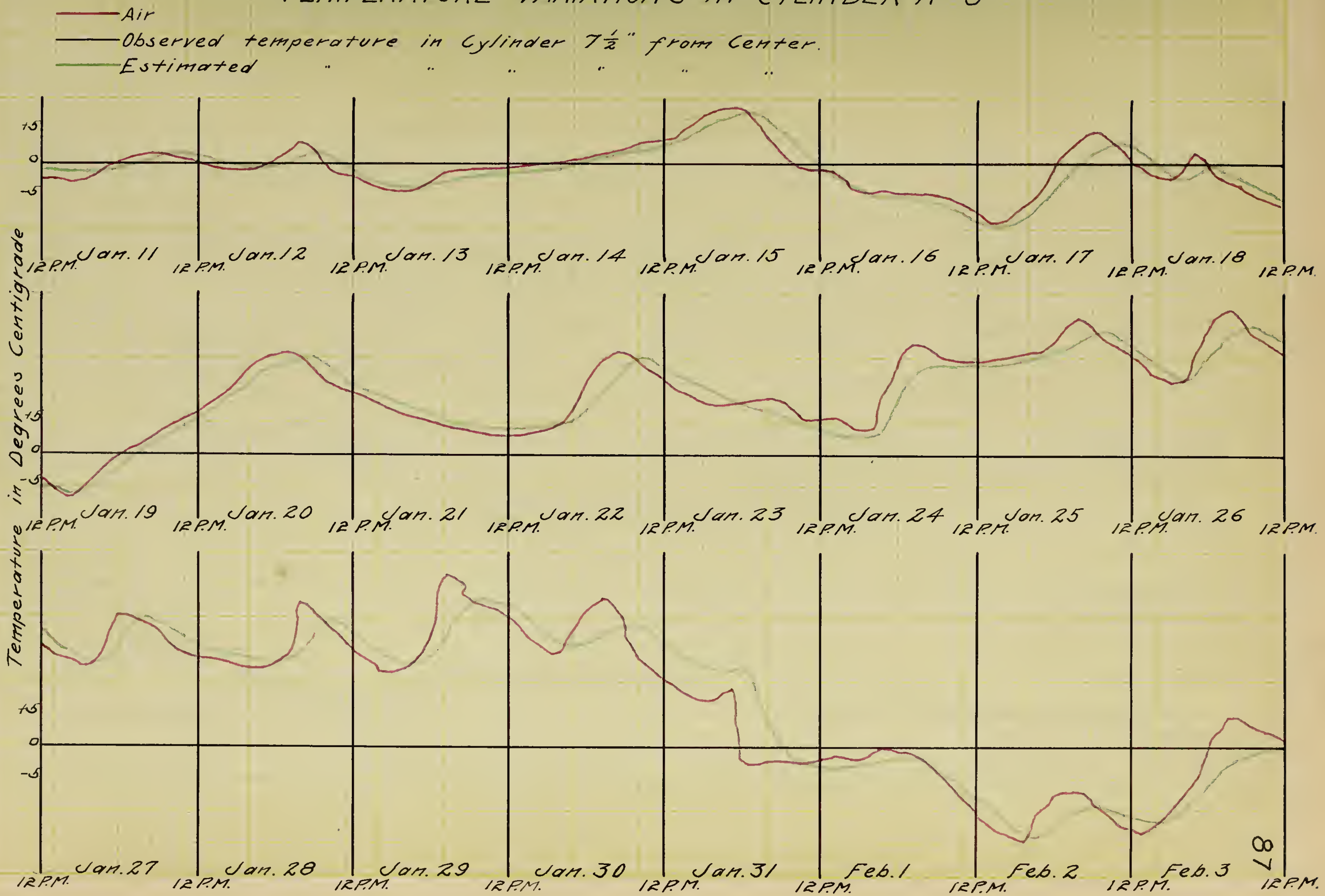

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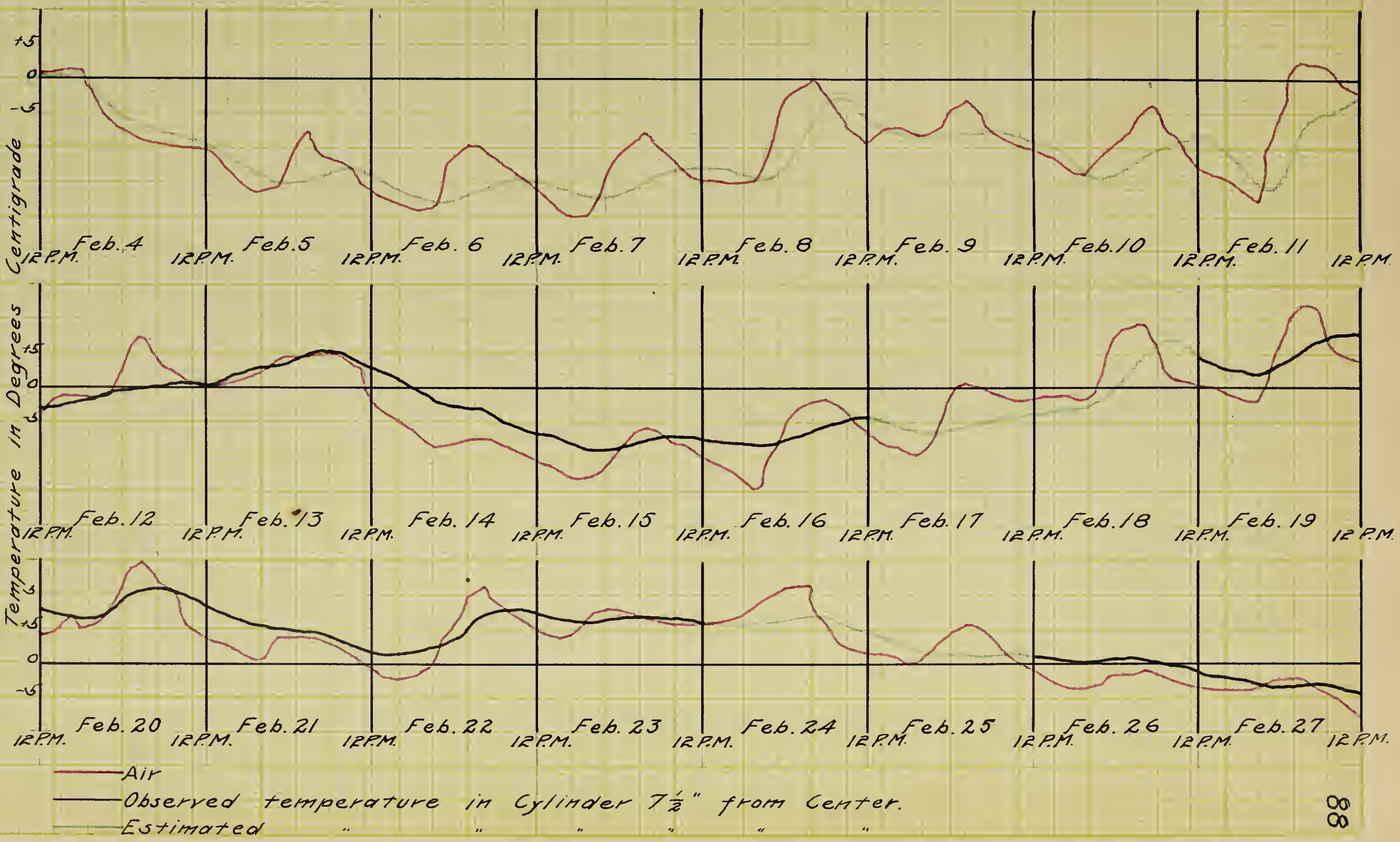

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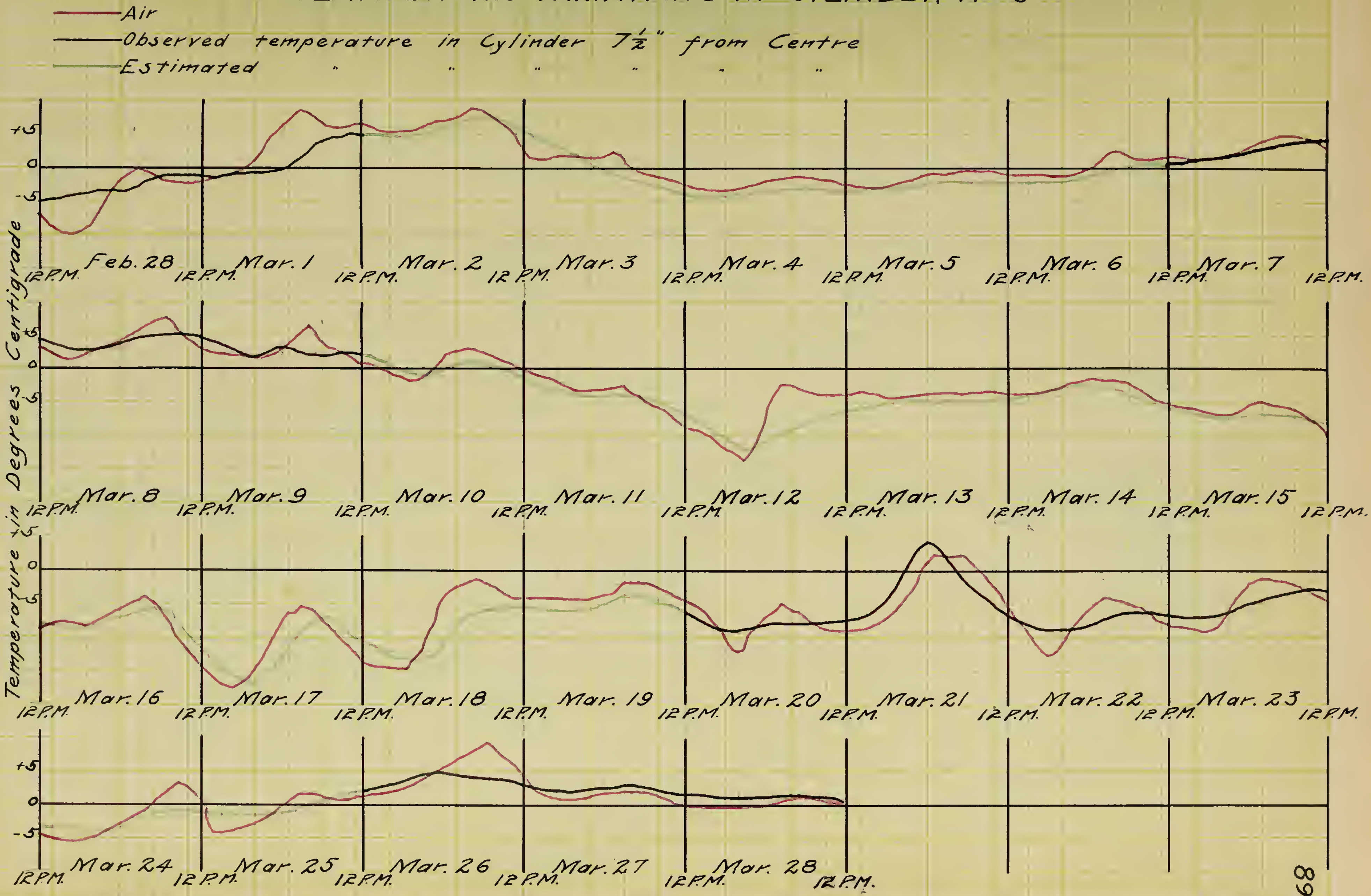

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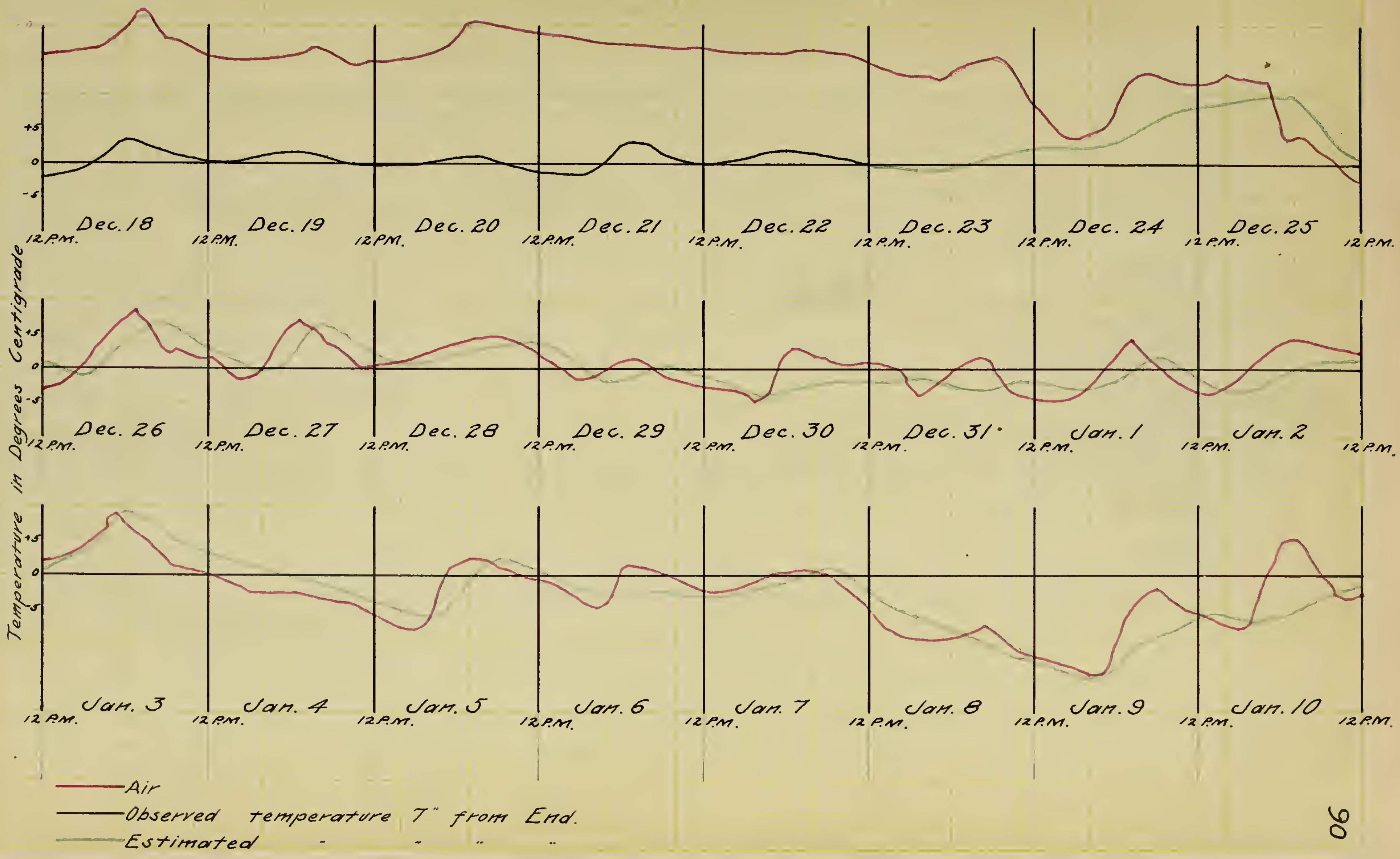

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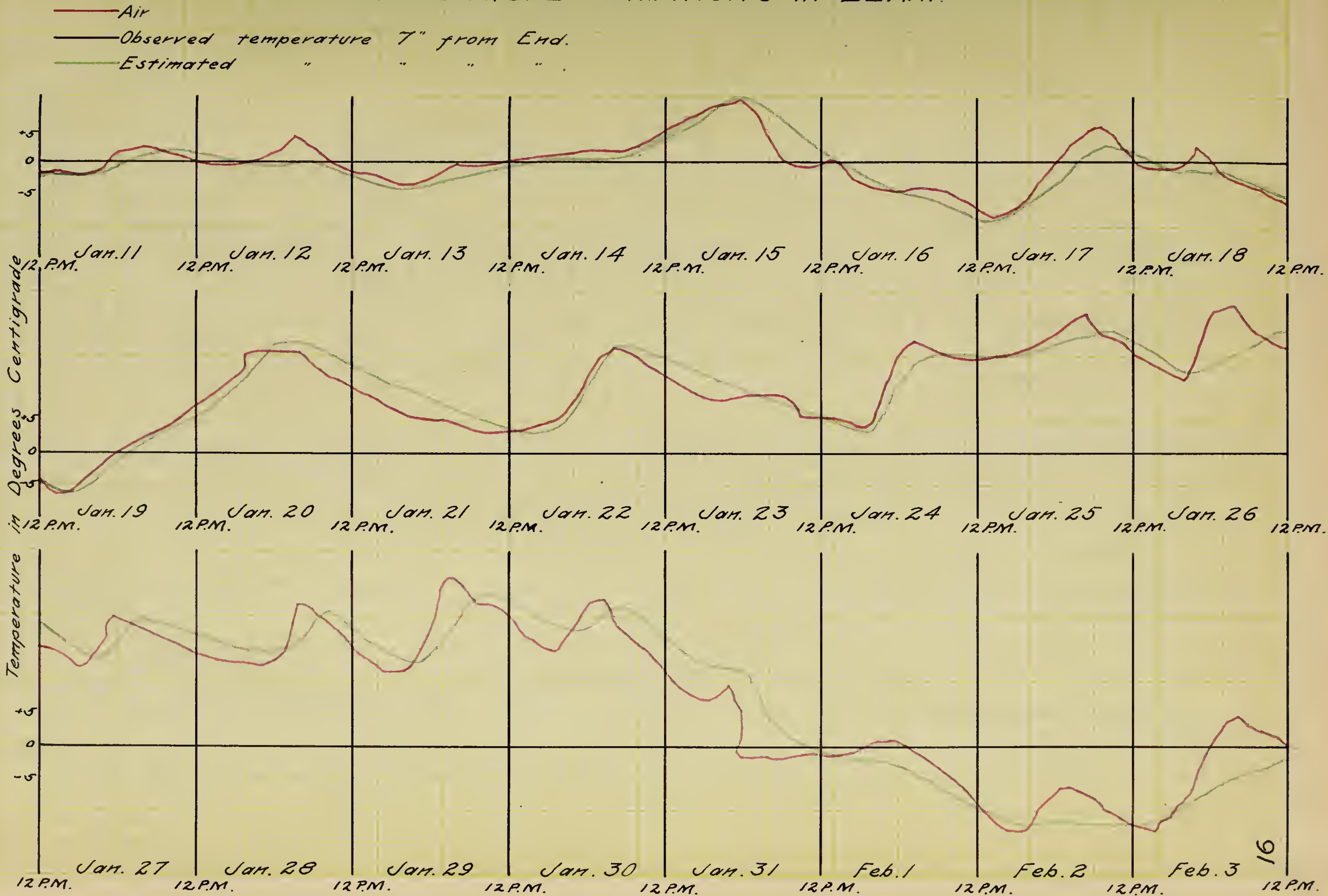

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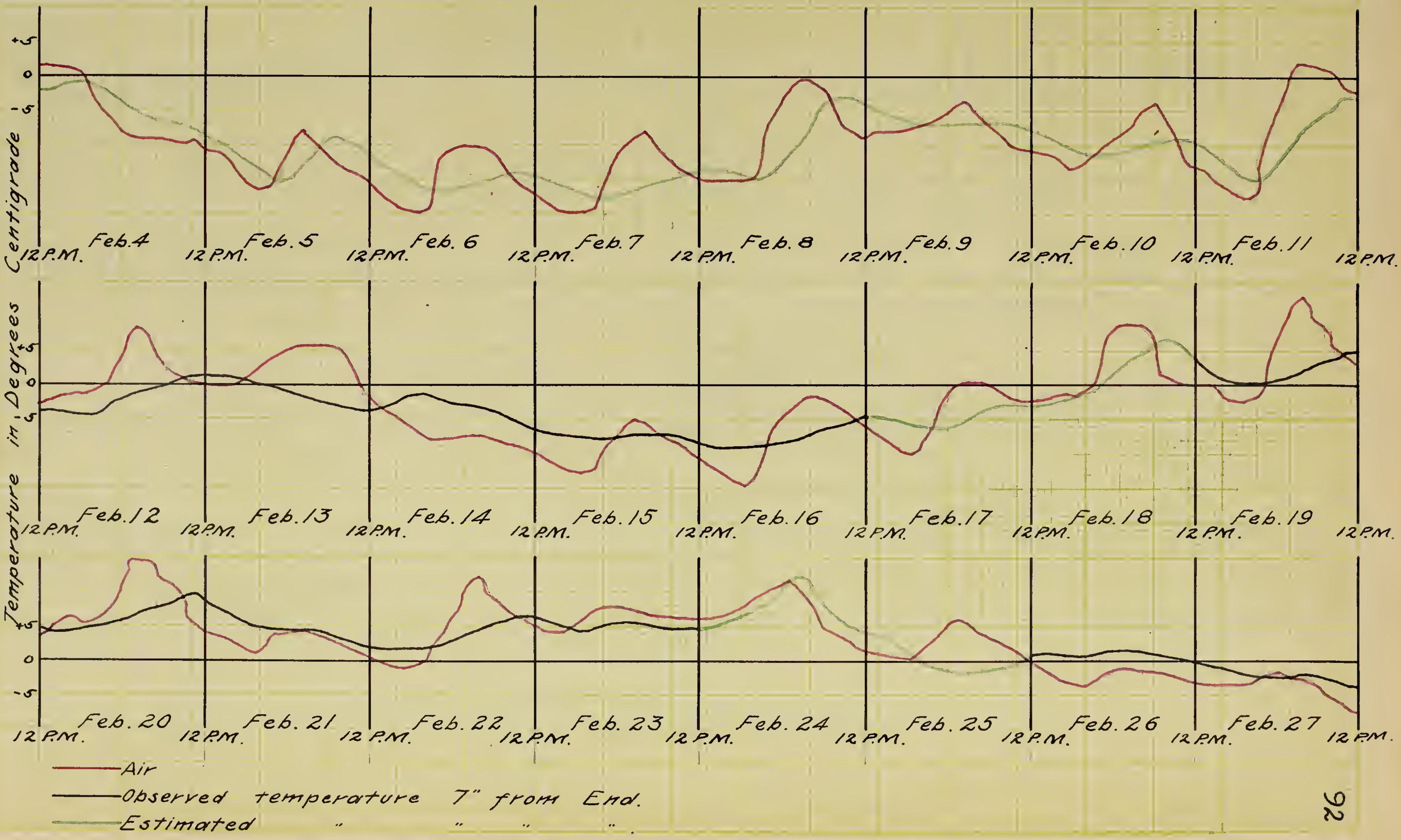

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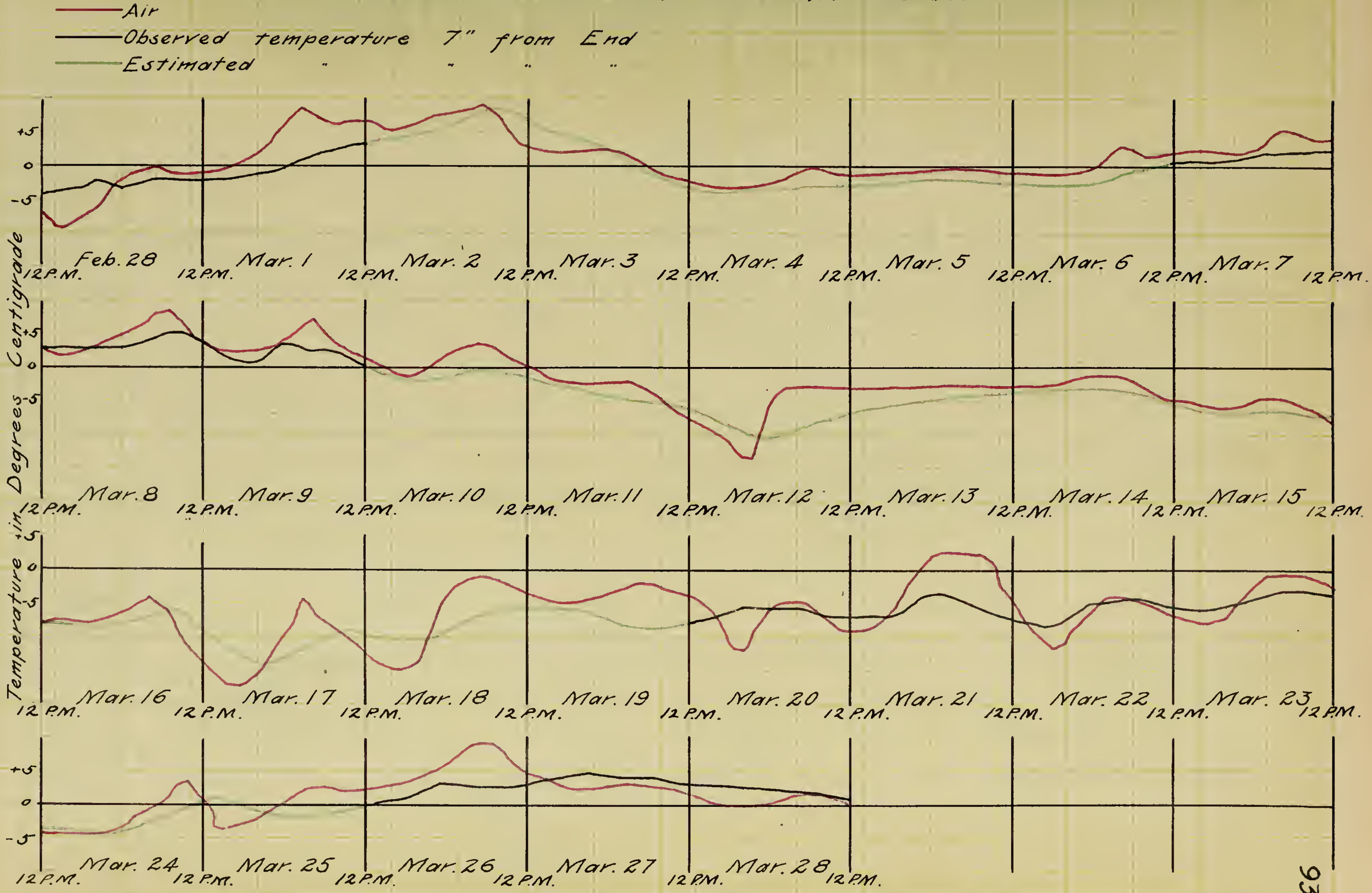

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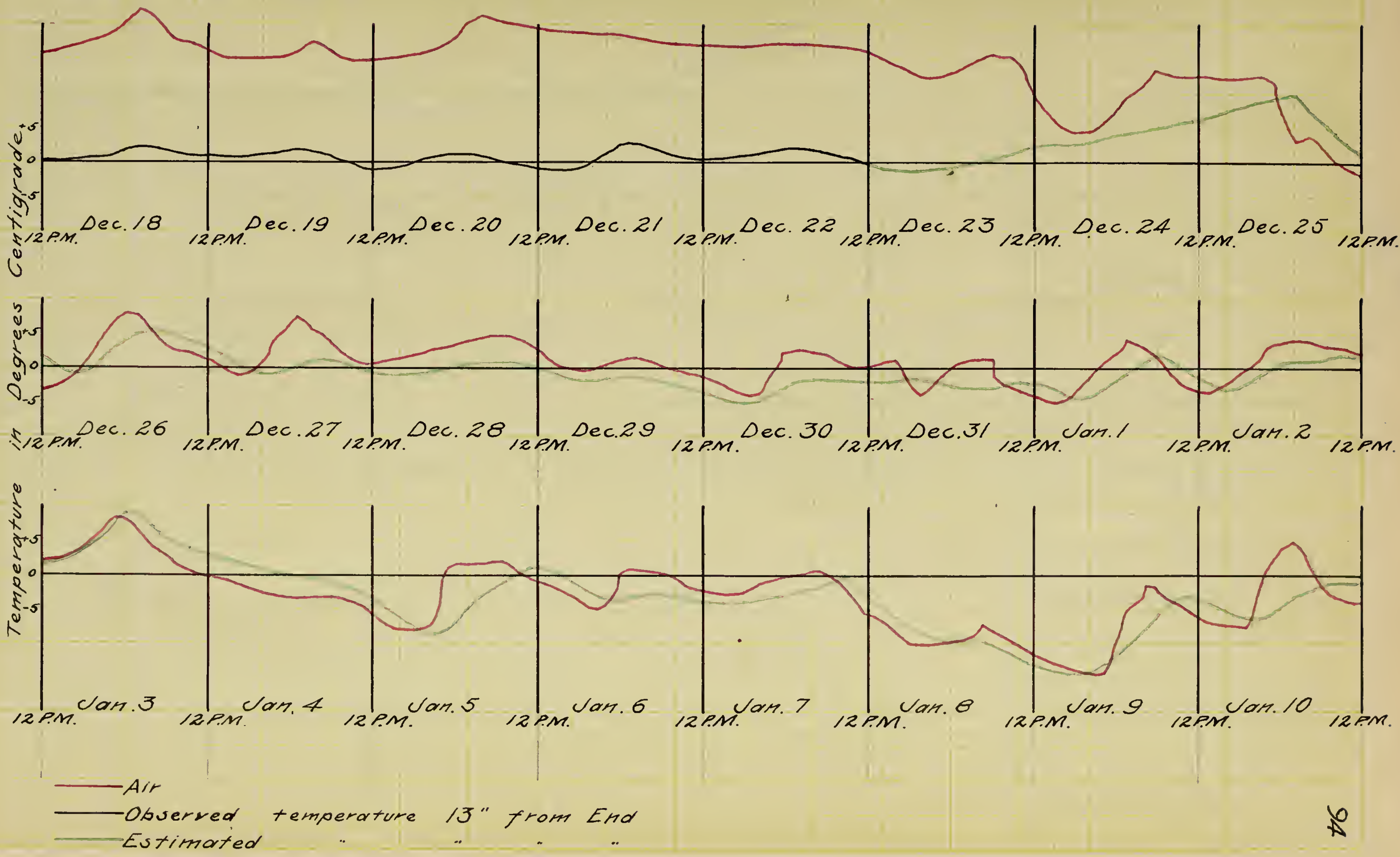

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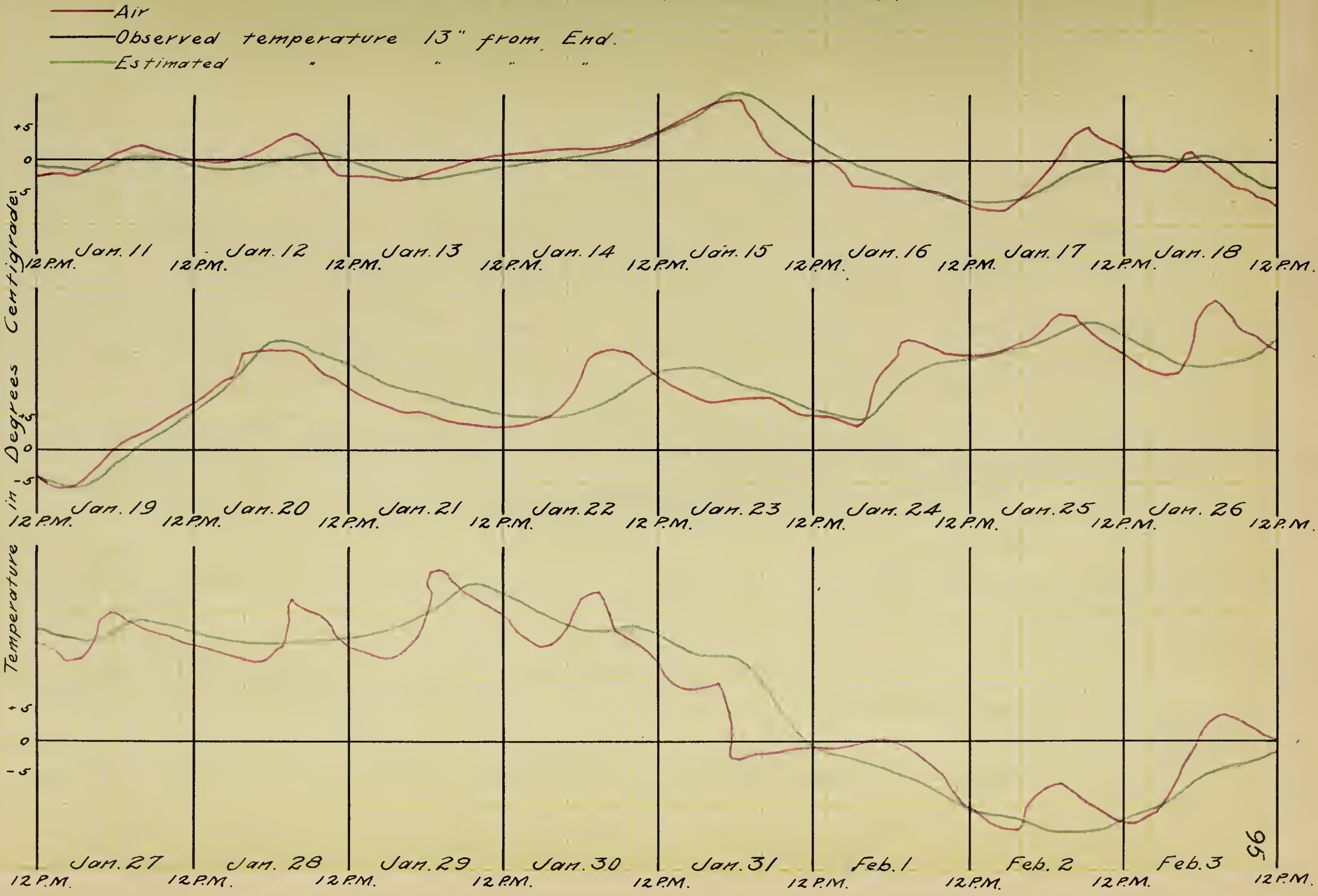

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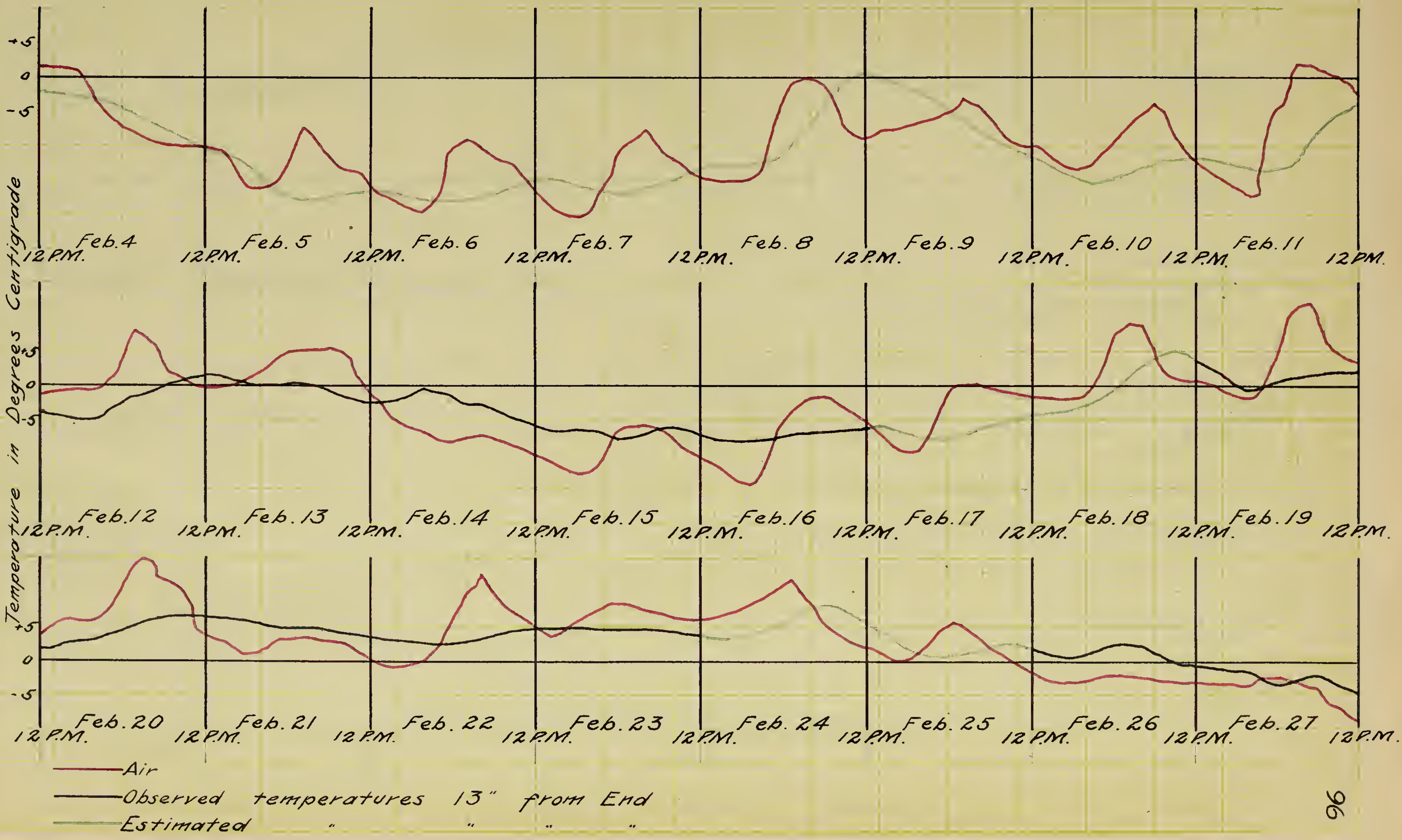

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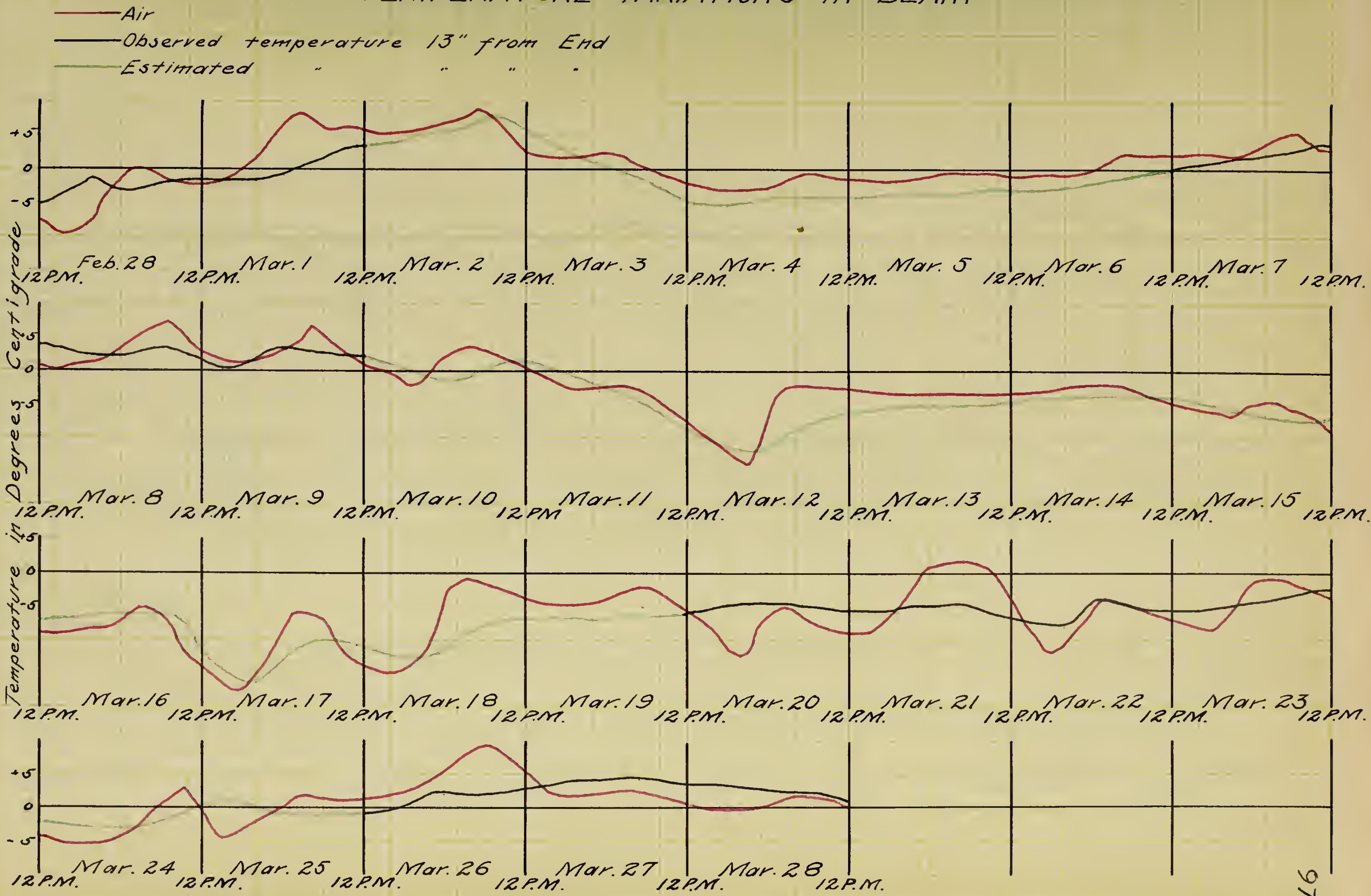

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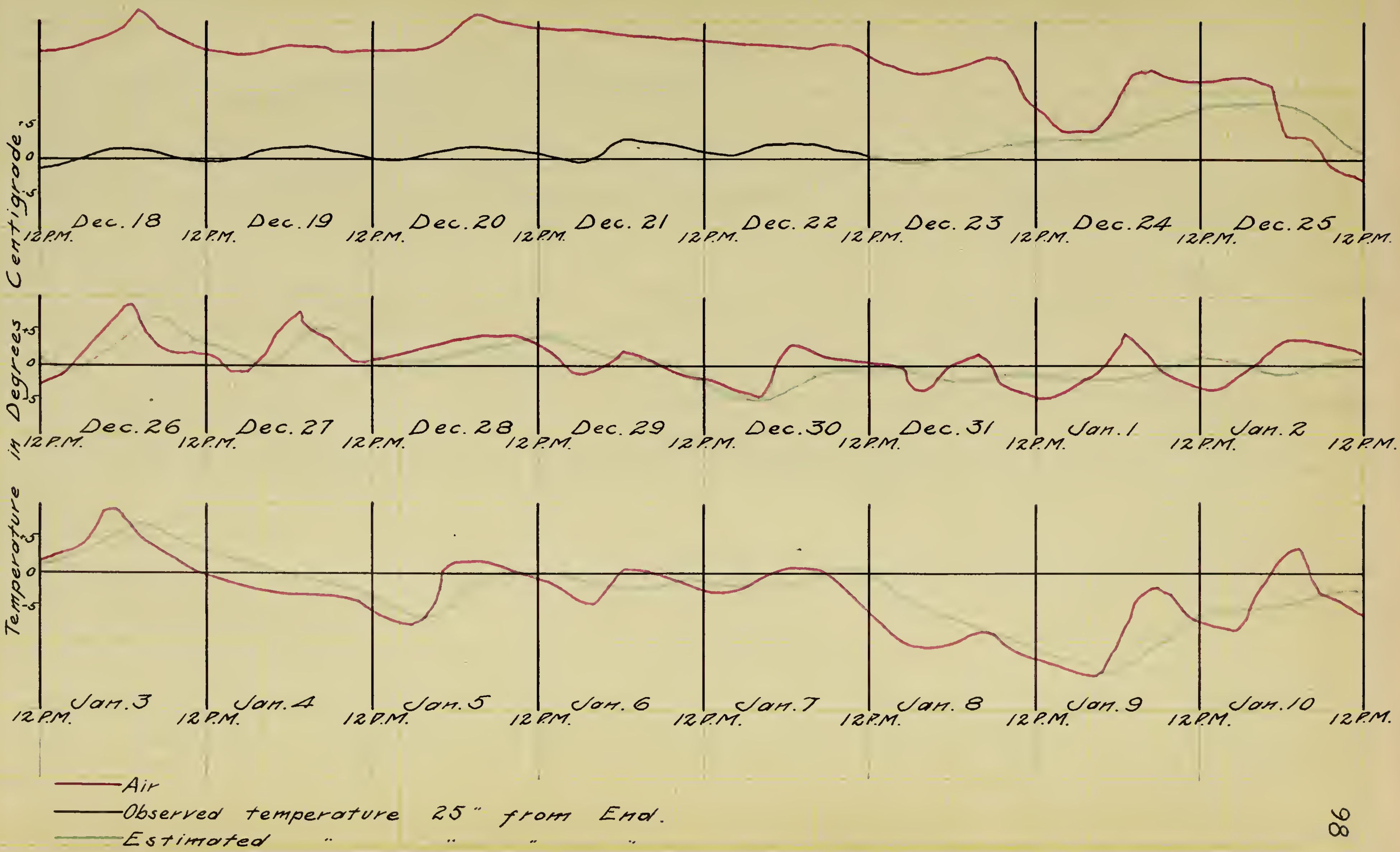

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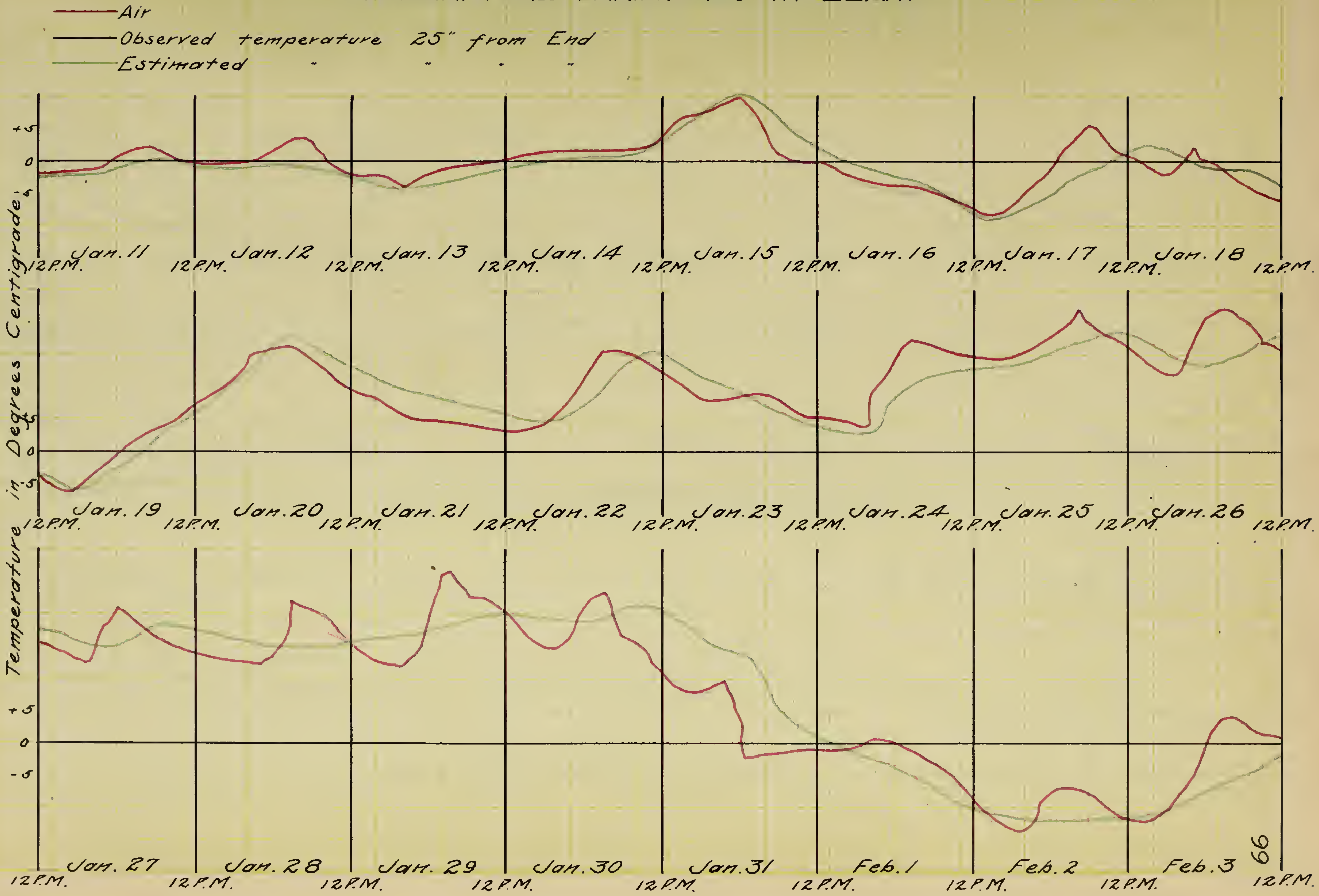

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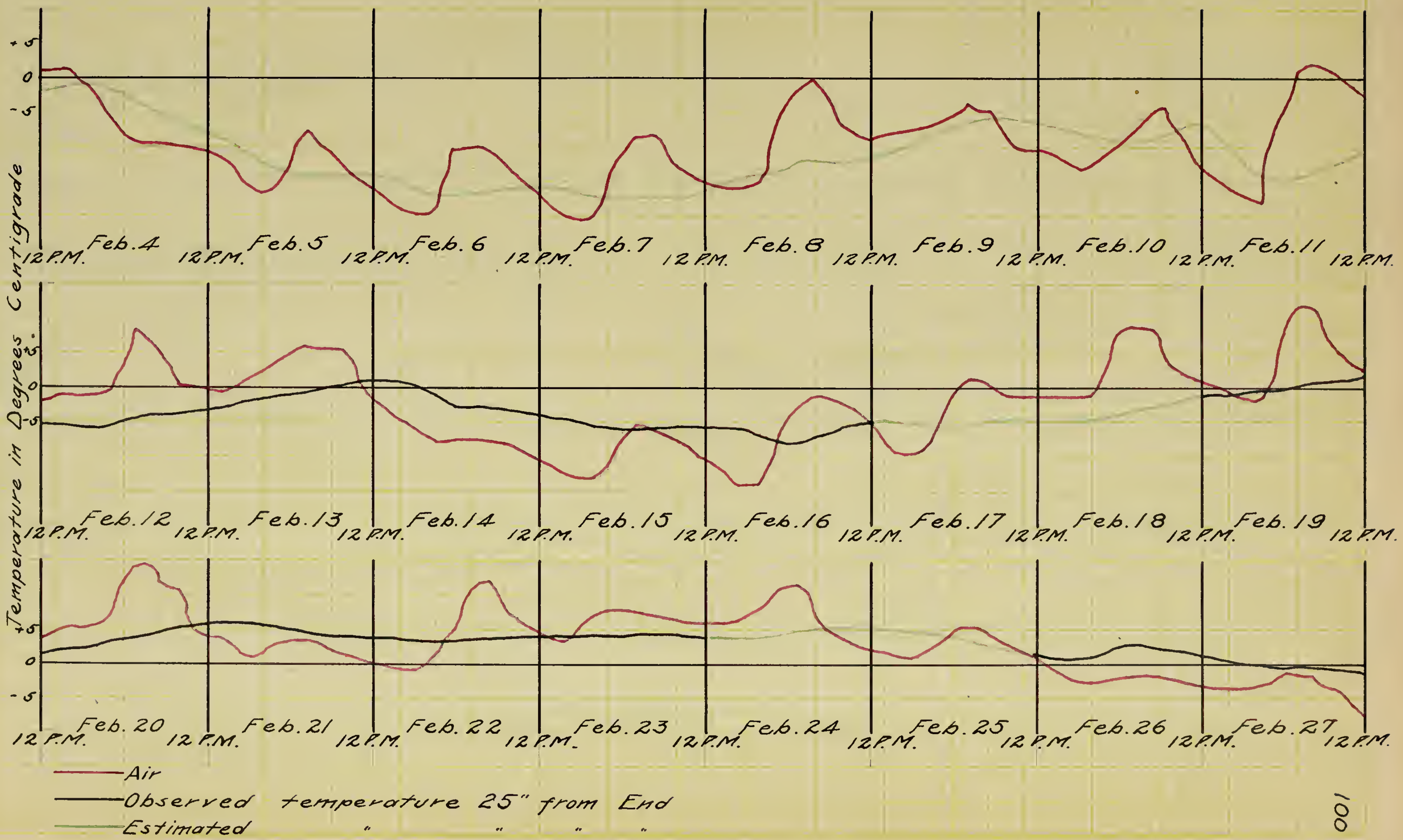

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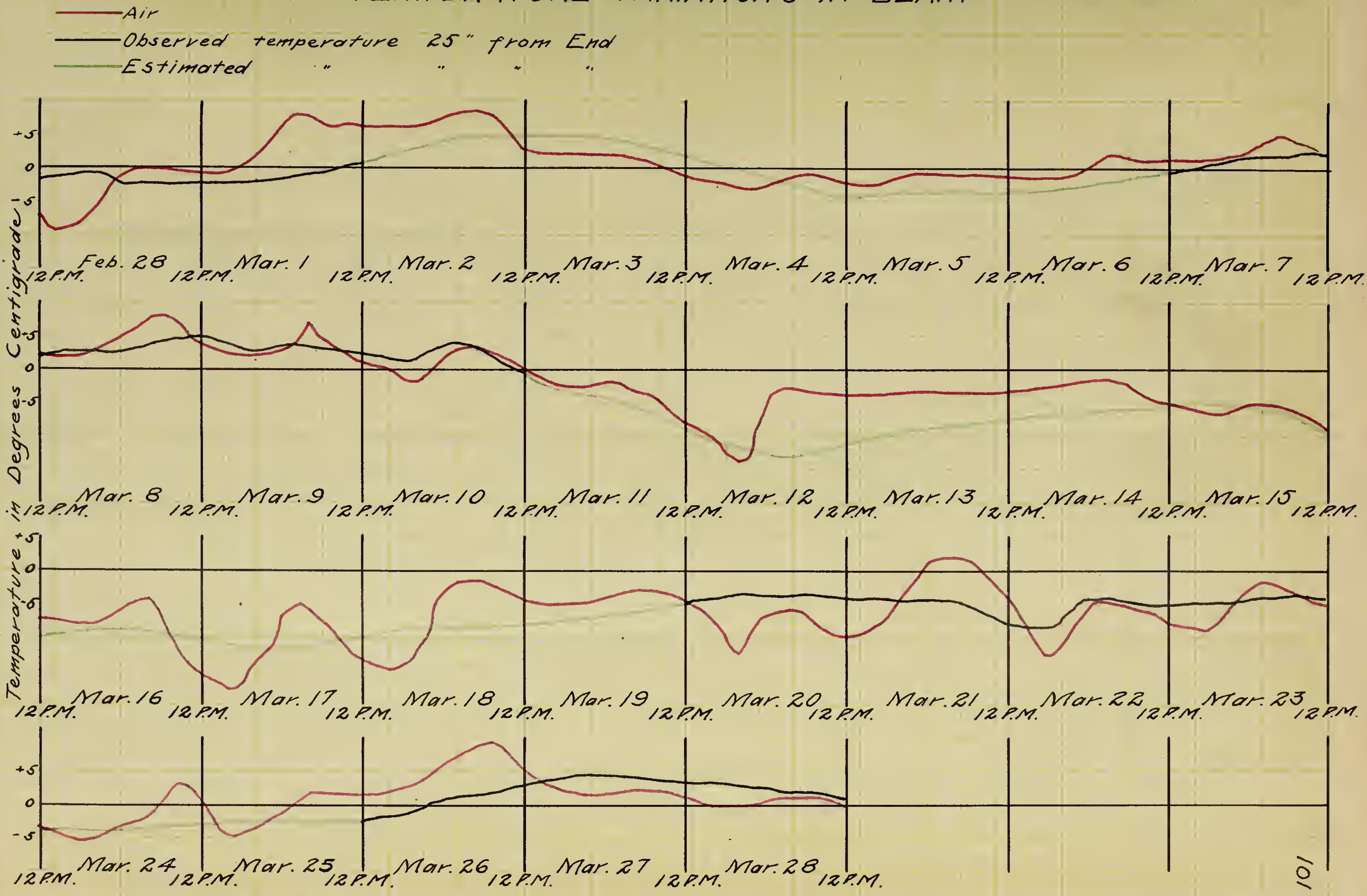

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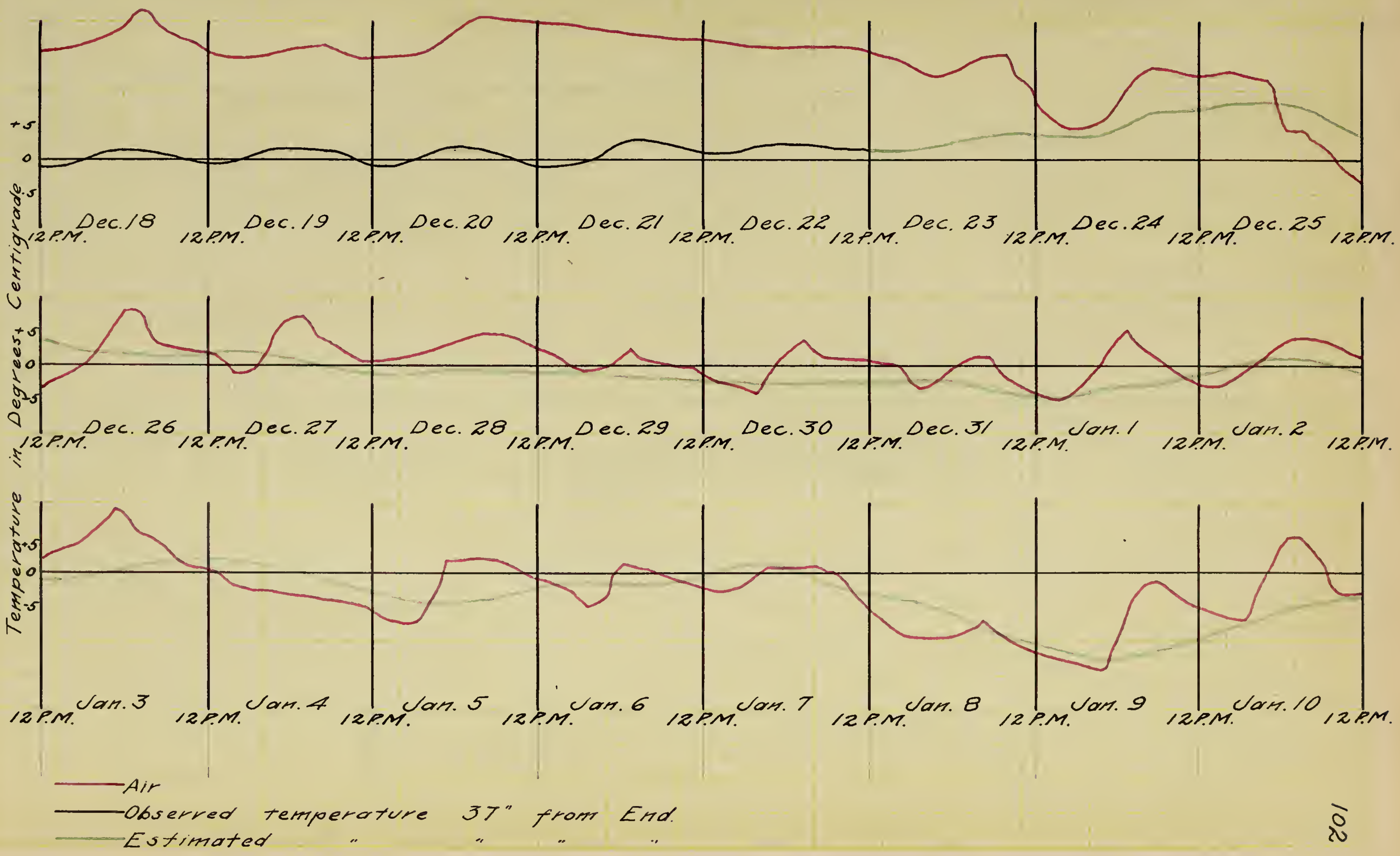

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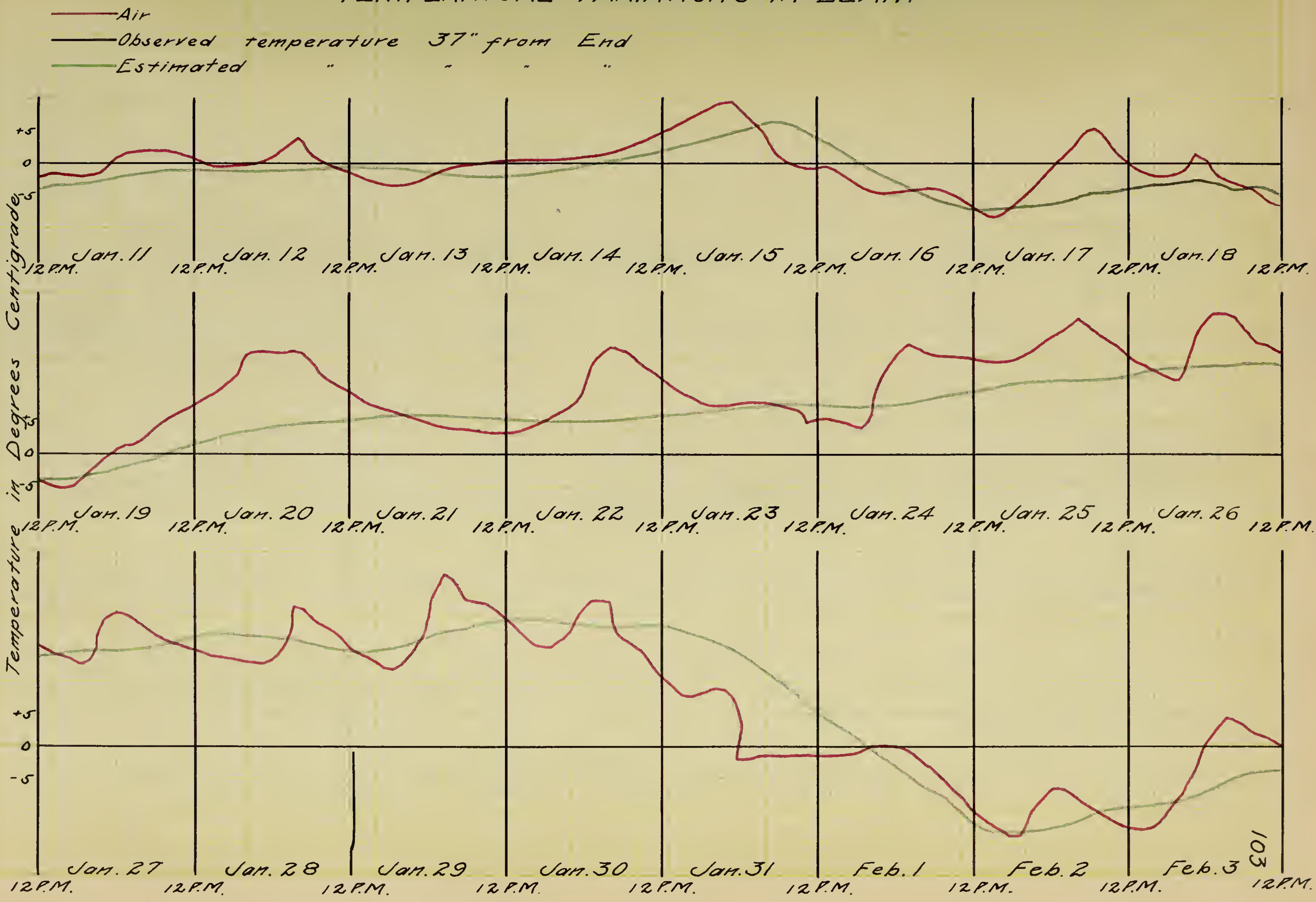

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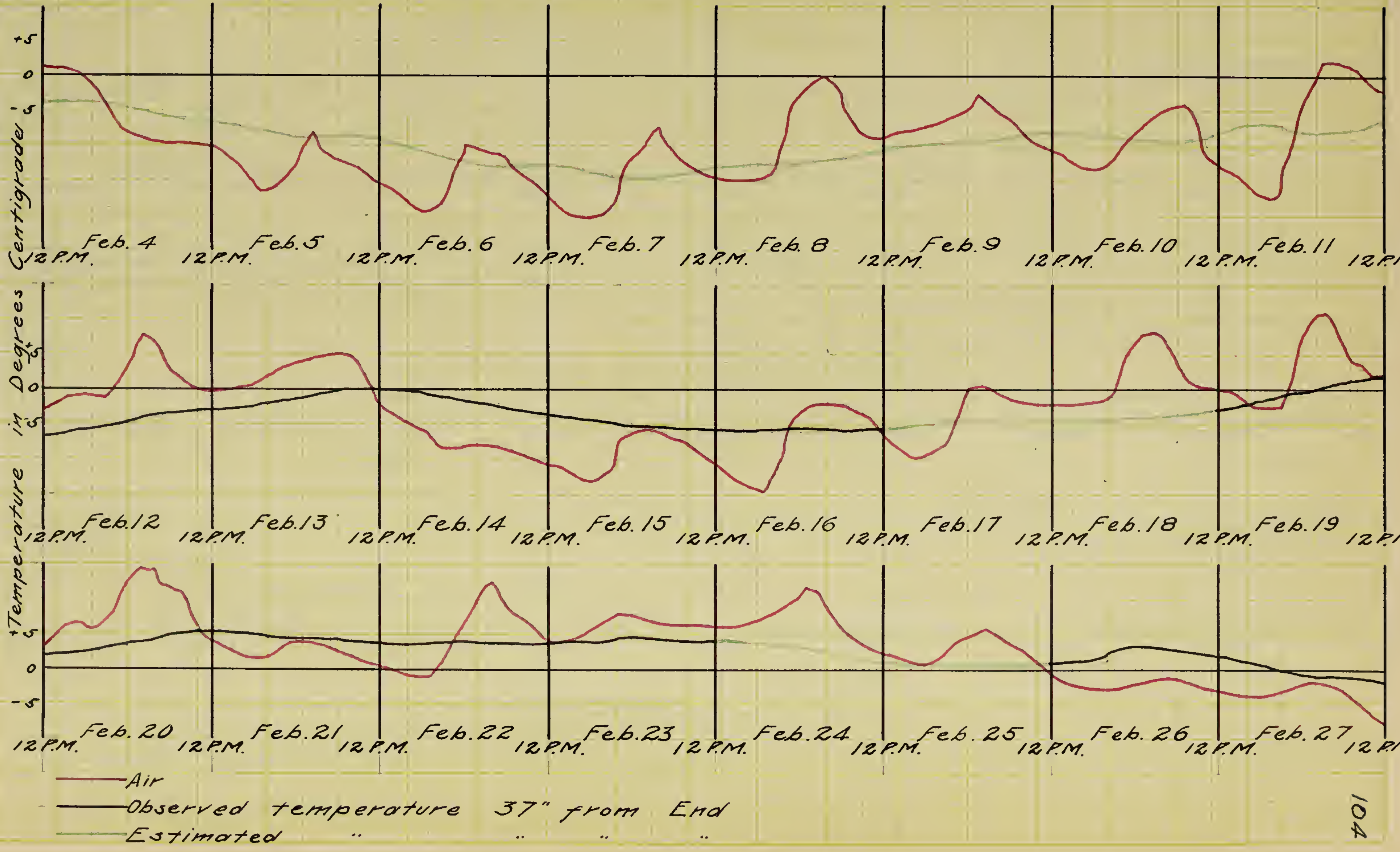

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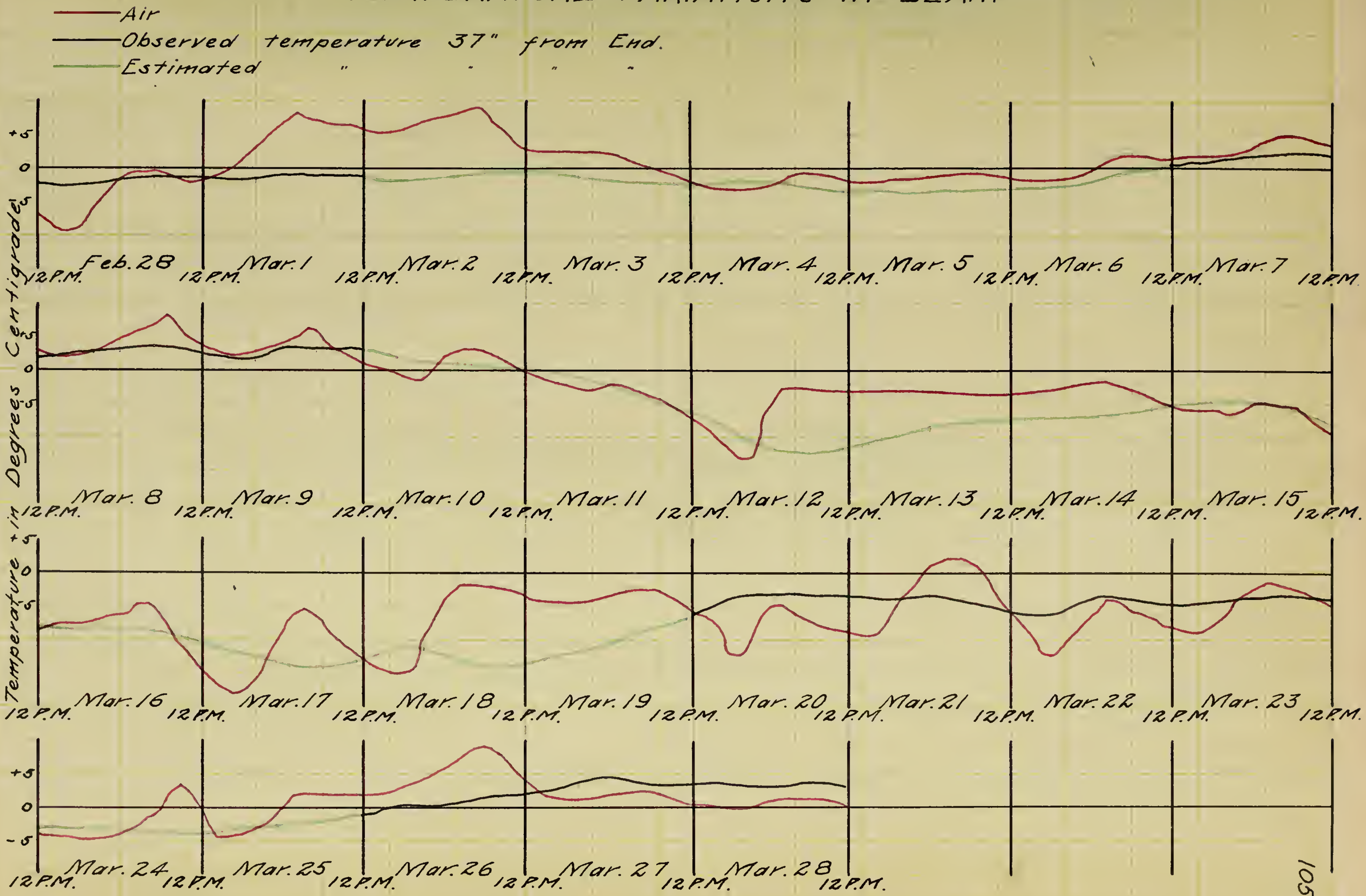

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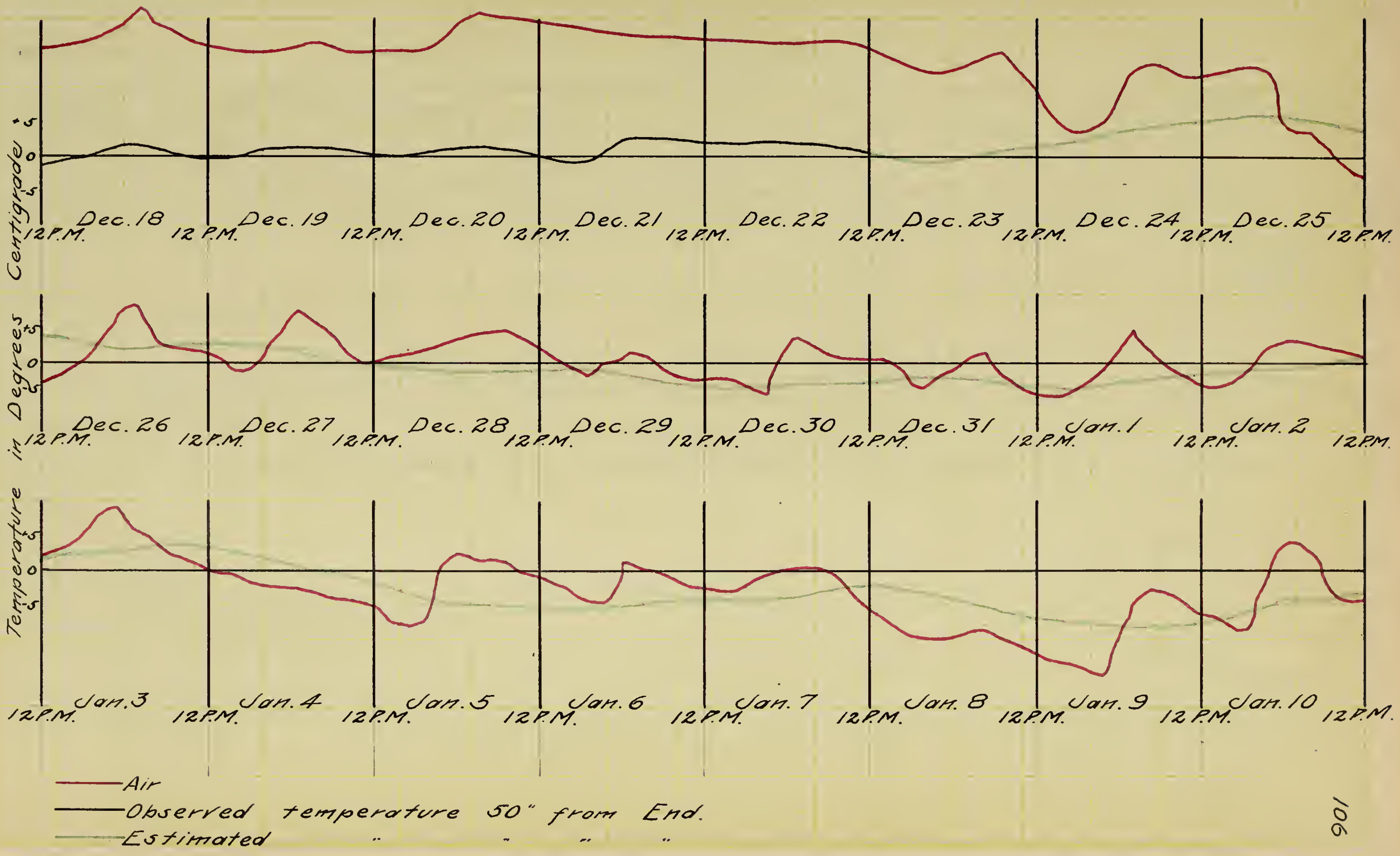

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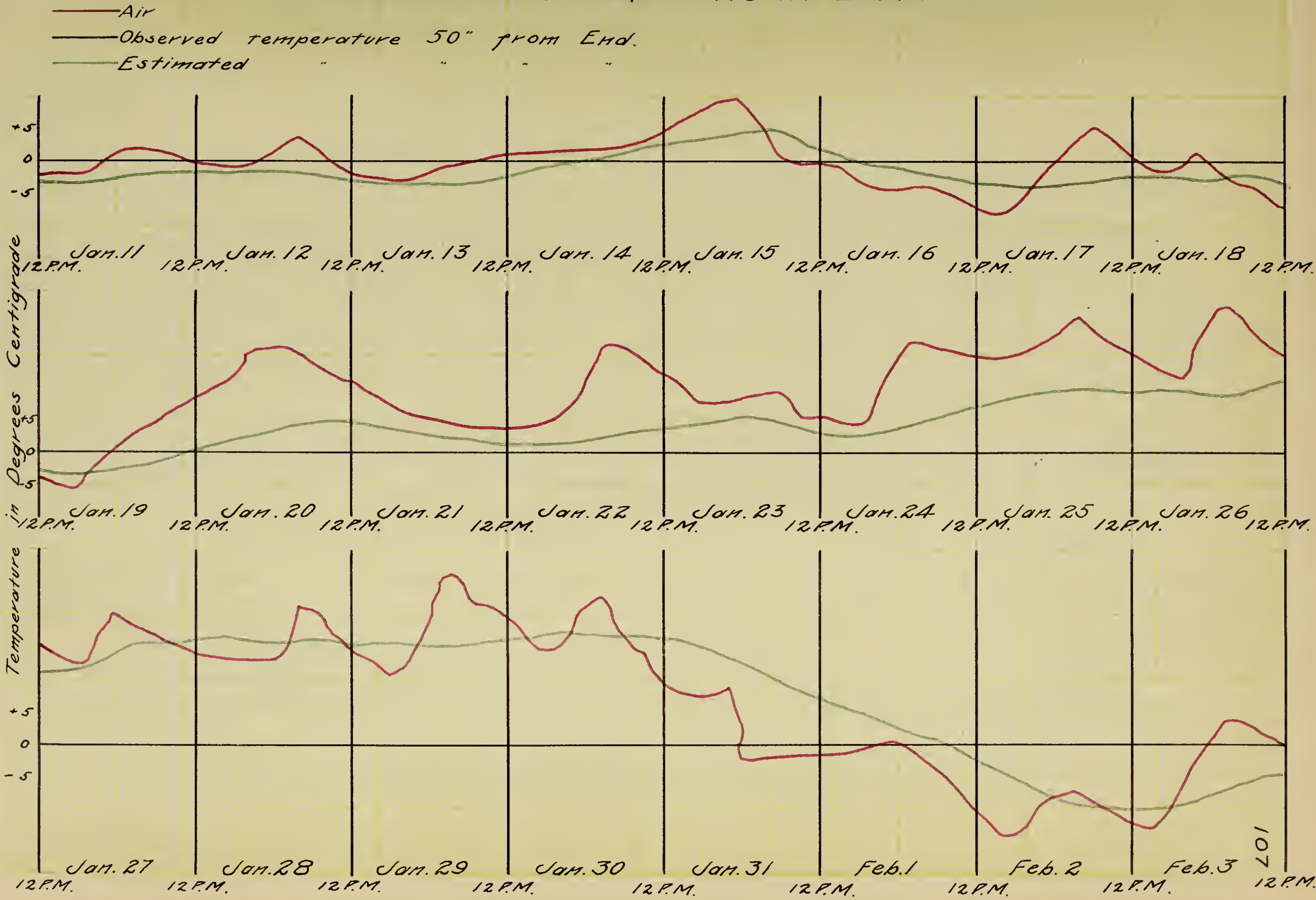

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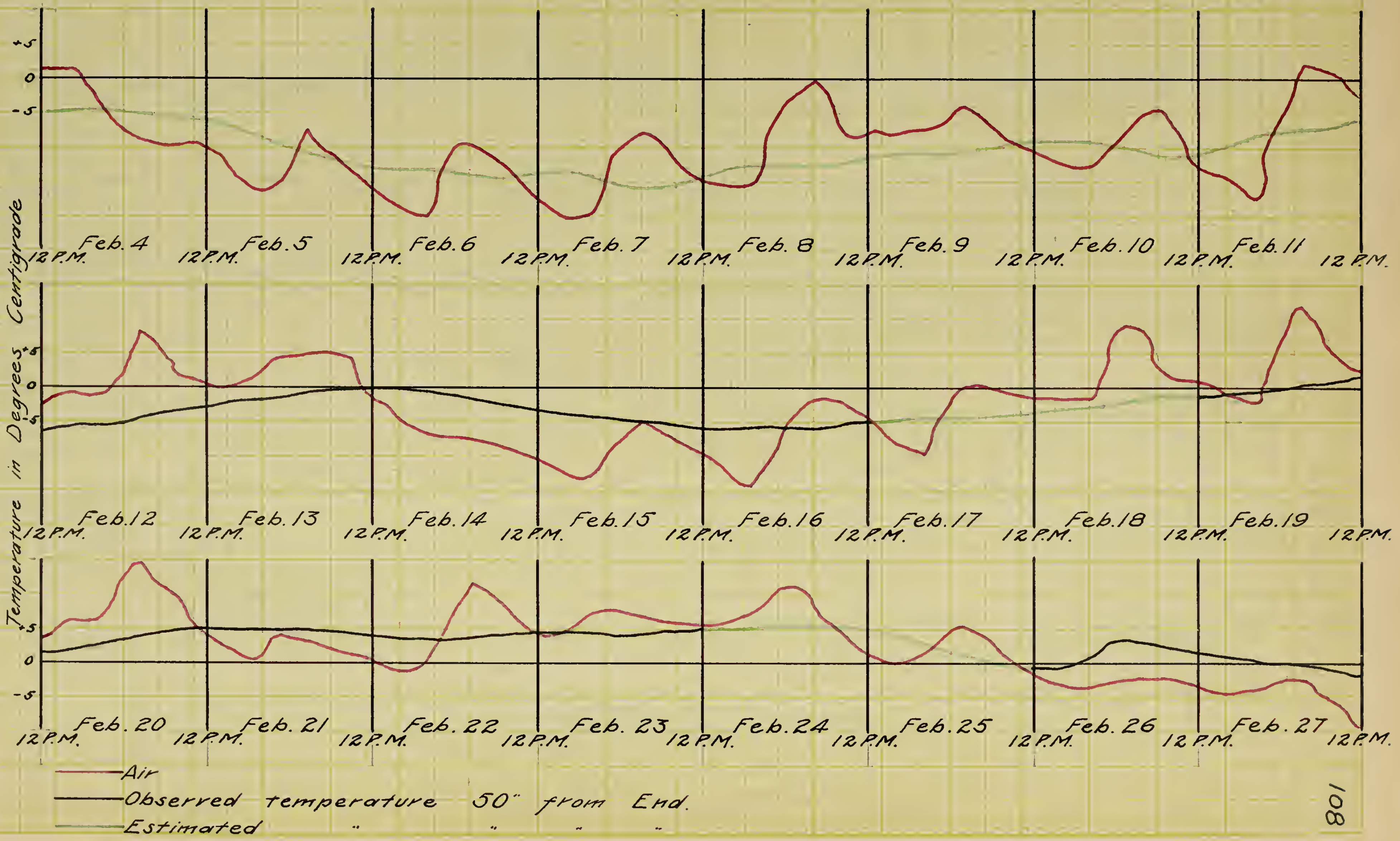

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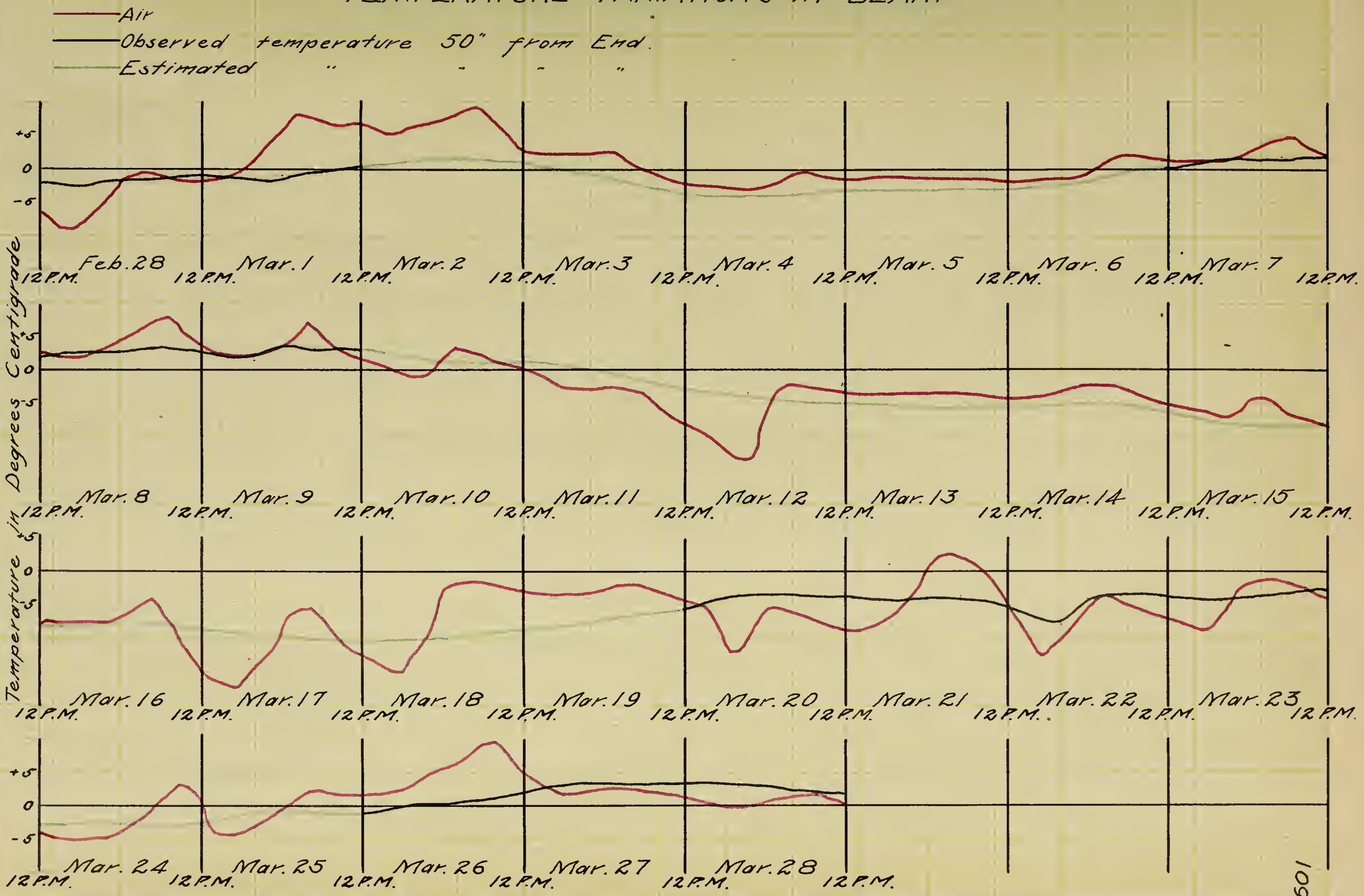

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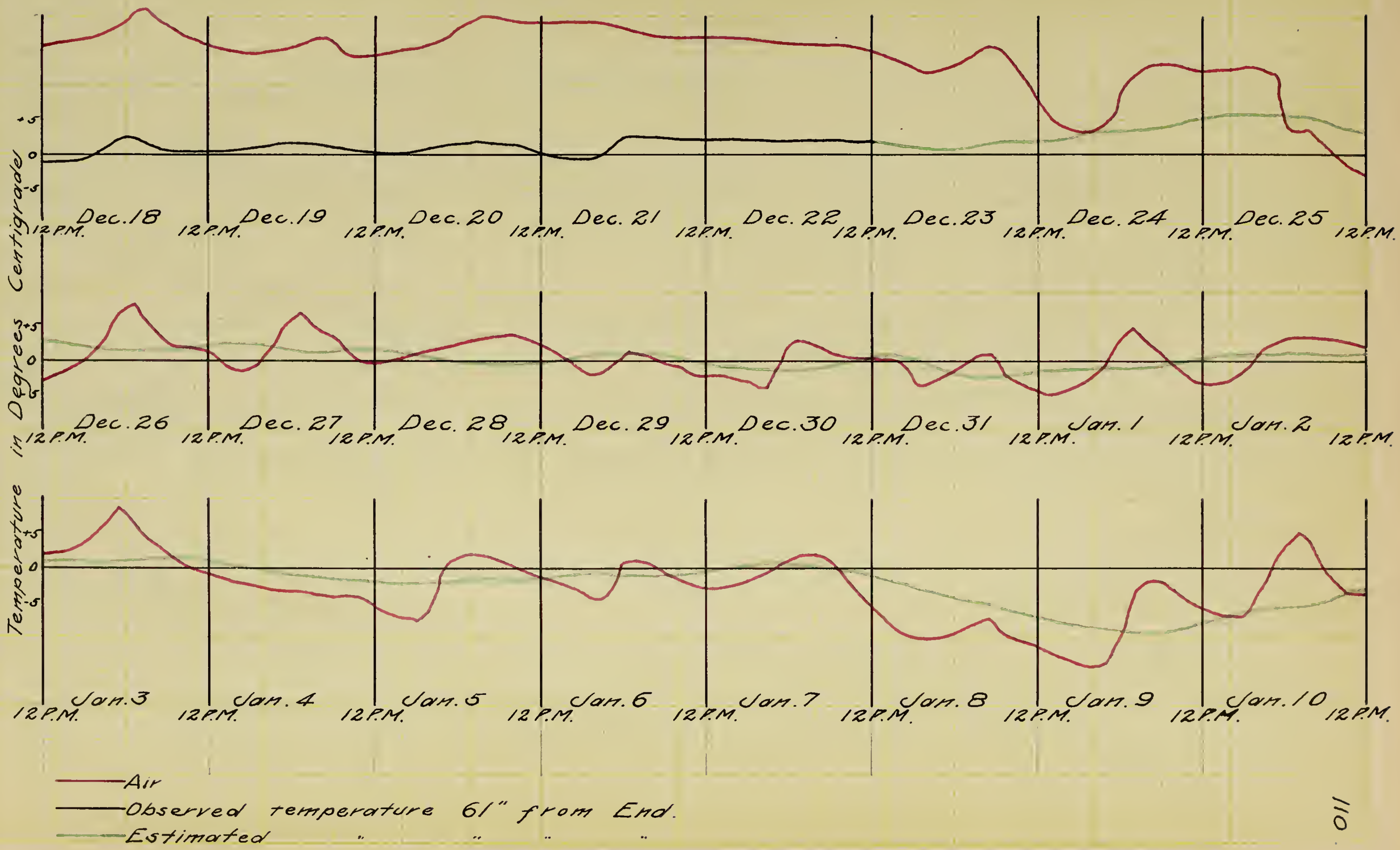

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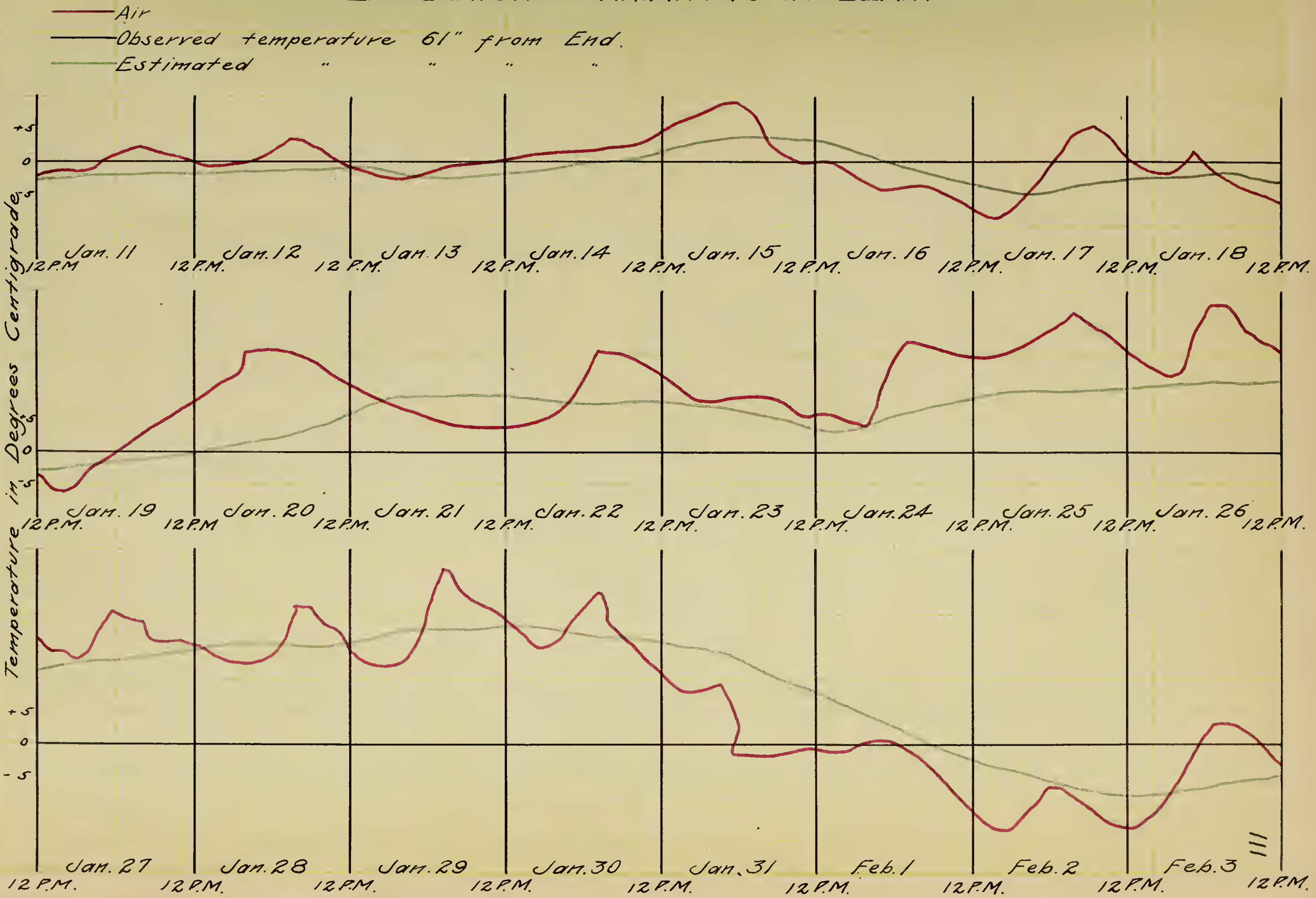

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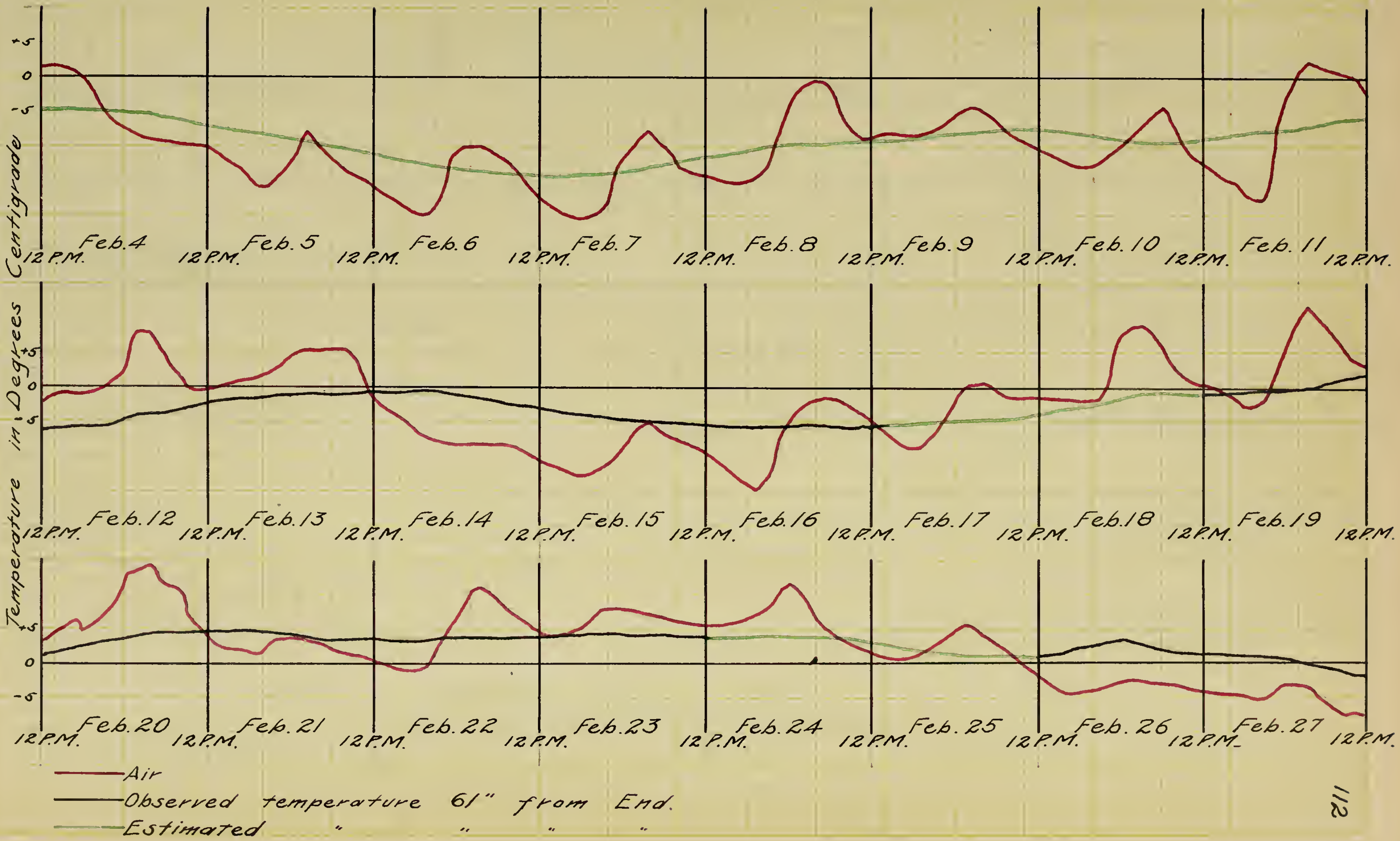

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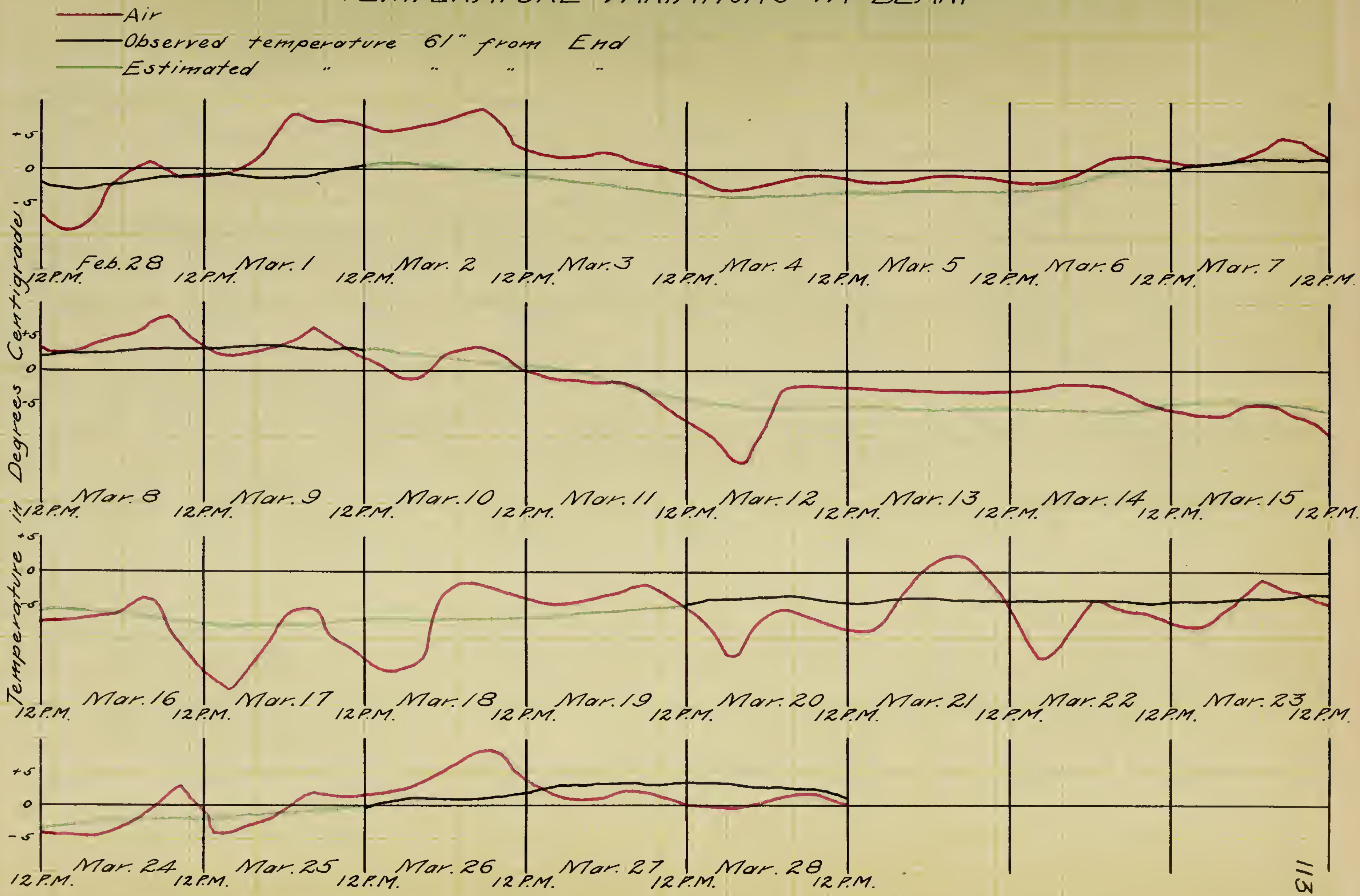

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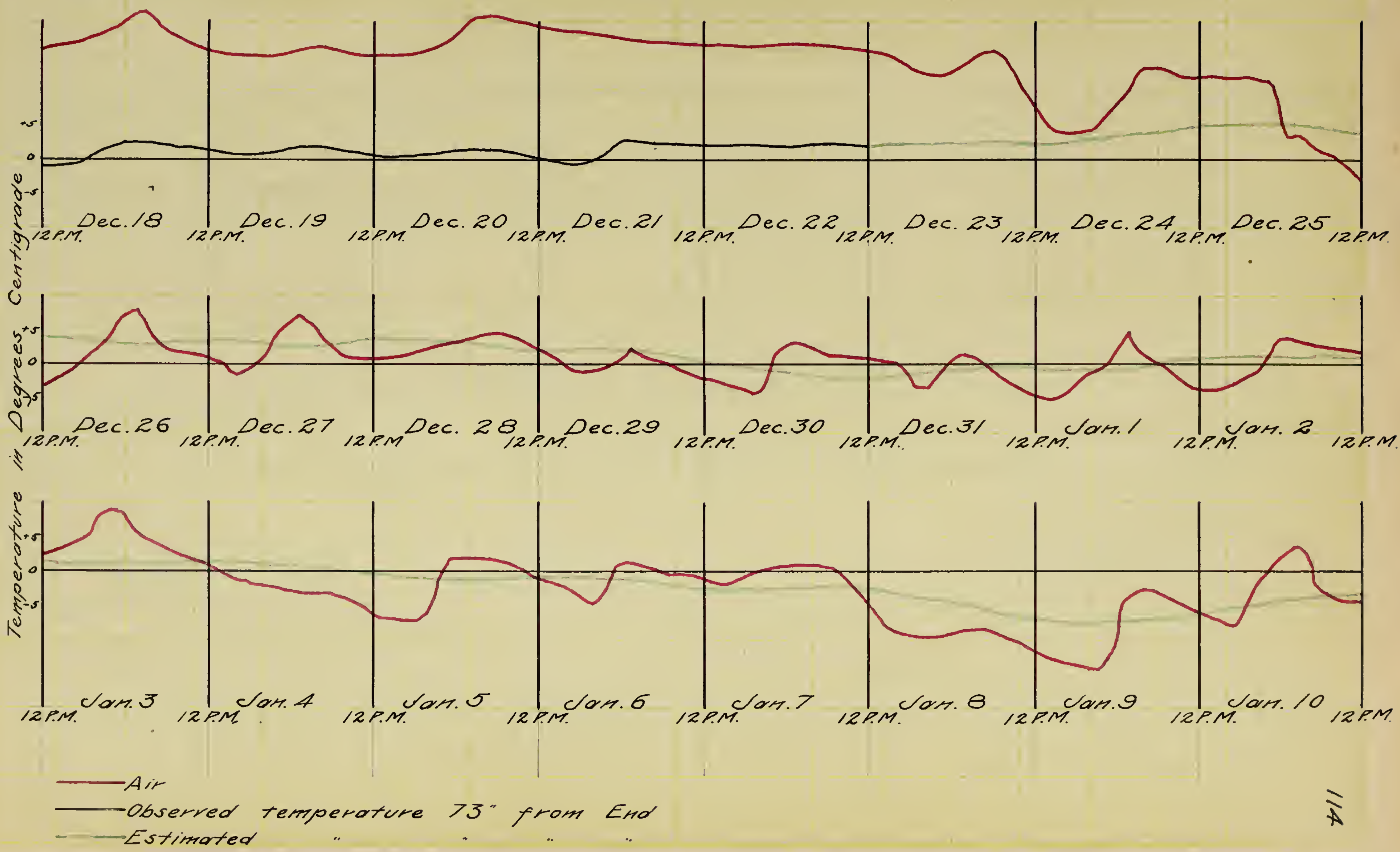

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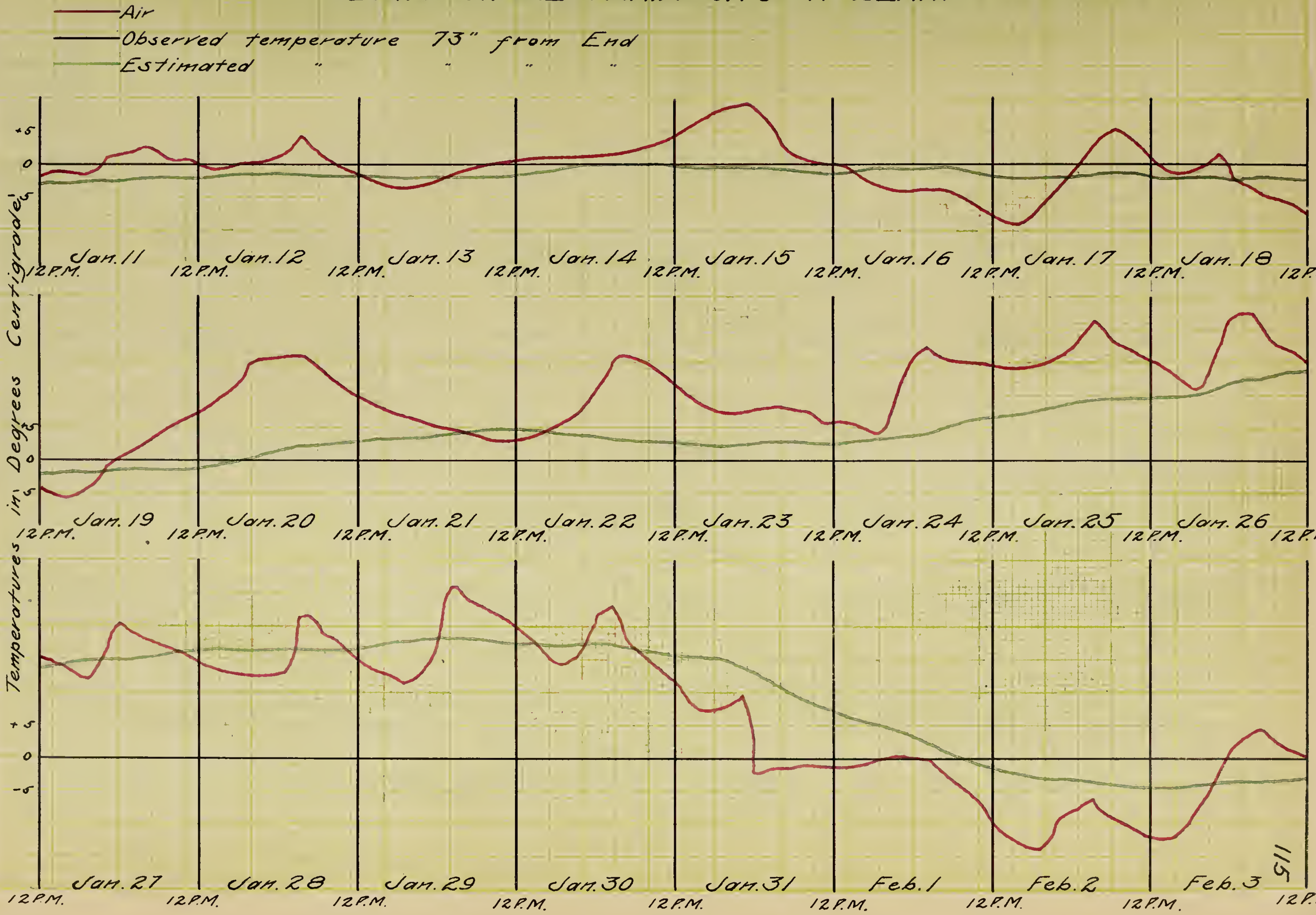

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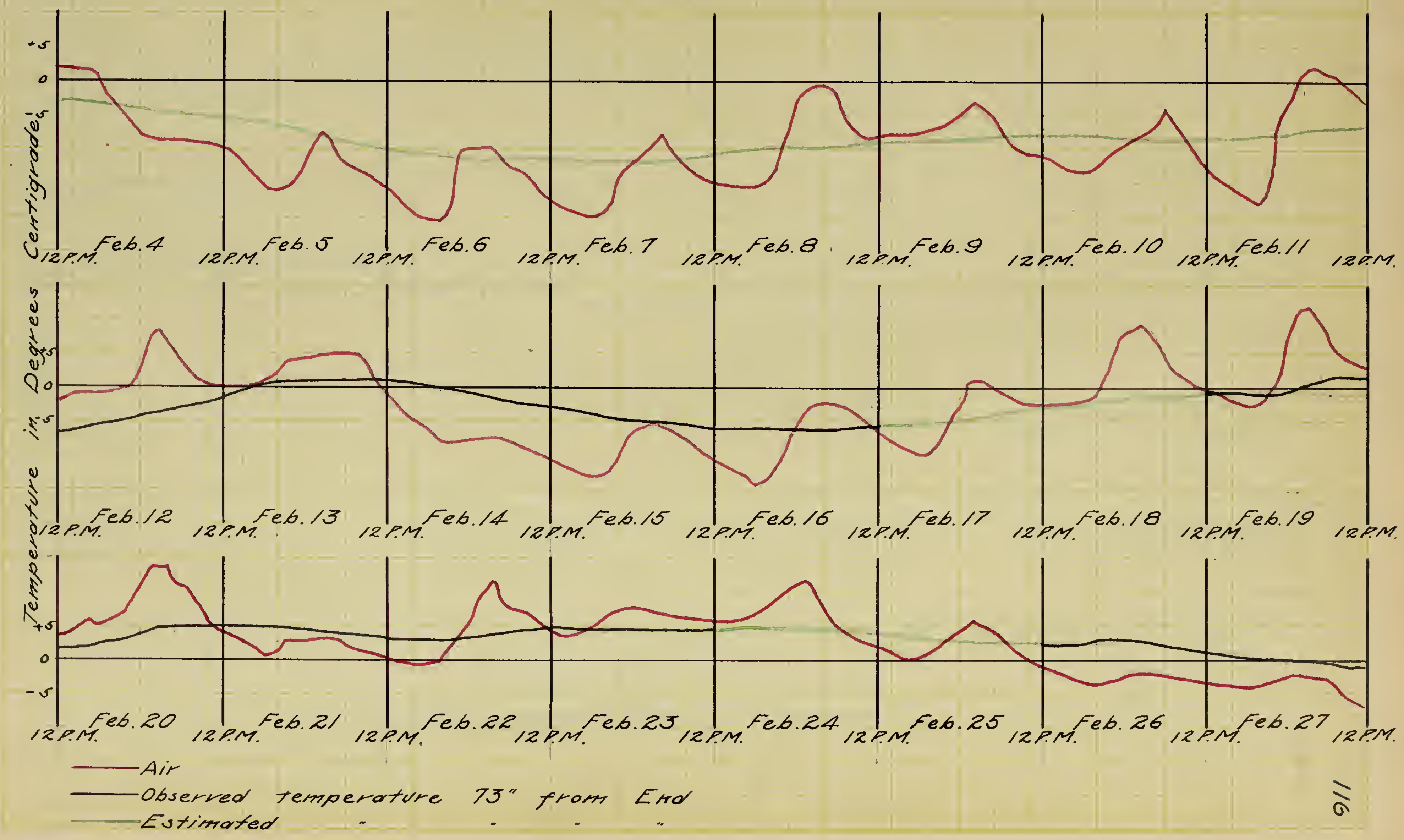

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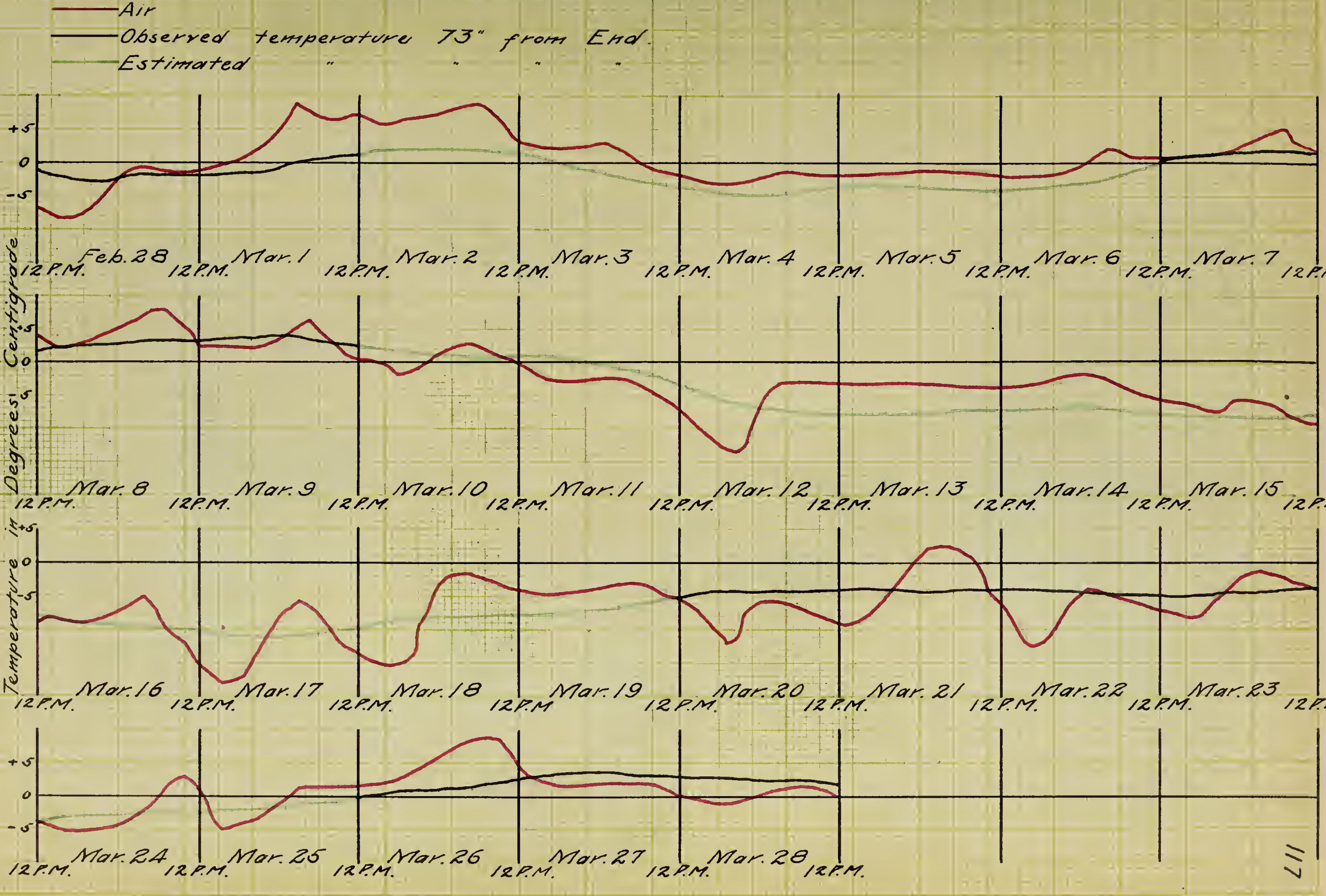

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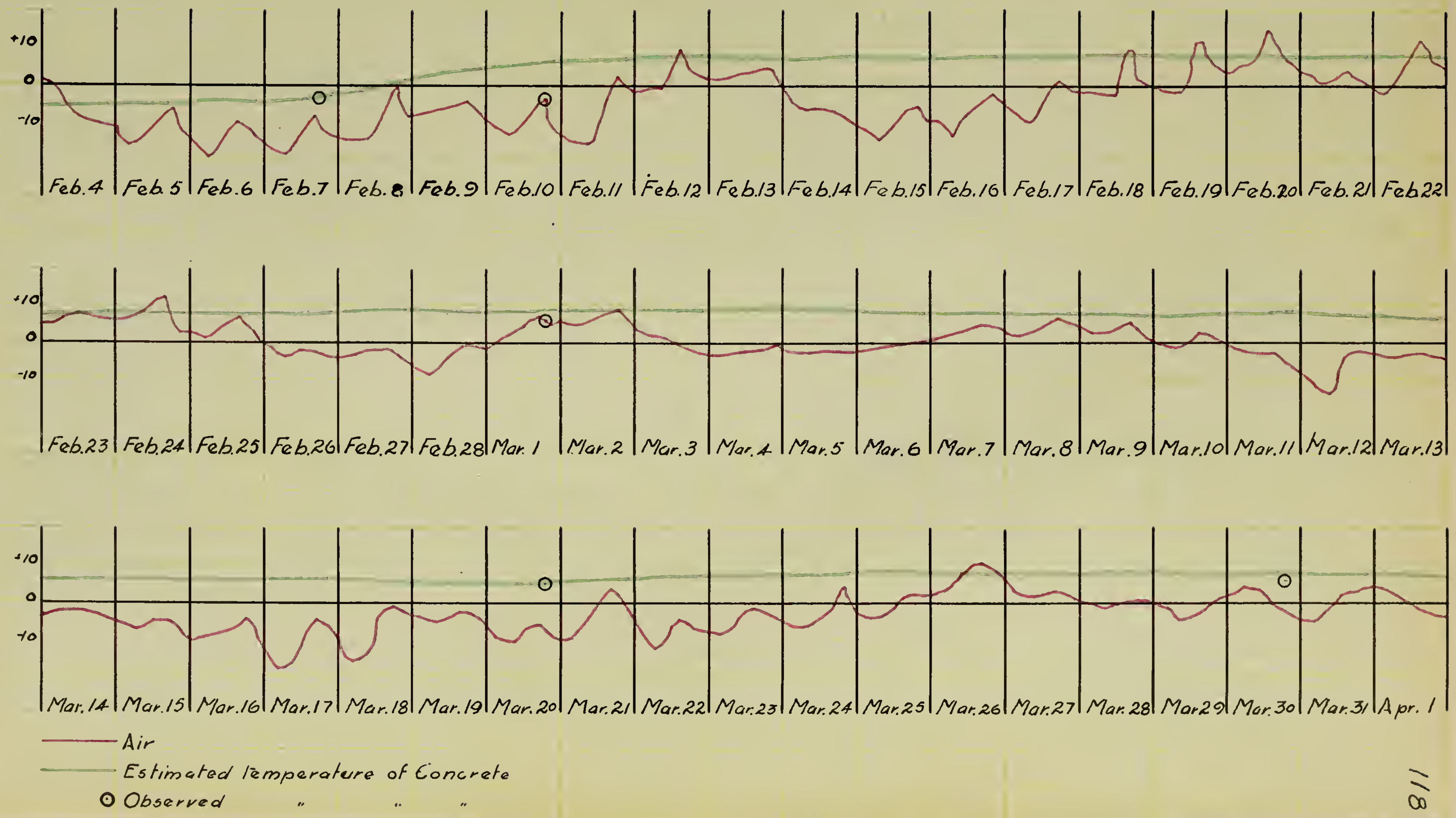

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